AN ATLAS

OF

CLINICAL MICROSCOPY,

BY

ALEXANDER PEYER, M.D.

TRANSLATED AND EDITED BY

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WITH ADDITIONS.

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CHROMO-LITHOGRAPHS.

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TO

AUSTIN FLINT, M.D., LL.D.,

PROFESSOR OF THE PRINCIPLES AND PRACTICE OF MEDICINE AND CLINICAL MEDICINE
IN BELLEVUE HOSPITAL MEDICAL COLLEGE,

THIS AMERICAN EDITION

IS RESPECTFULLY AND GRATEFULLY INSCRIBED

BY THE TRANSLATOR.

PREFACE OF THE TRANSLATOR.

During a trip abroad, last summer, I saw, in a medical journal, favorable comments on a work just published by Dr. Peyer, of Schaffhausen, entitled "Microscopie am Krankenbette." I purchased the book, and found that the plates were most excellent, and that, with a few additions needed, owing to the fact that relatively too much space was given to examination of the urine, a translation and republication of it in this country would supply a want in American medical literature, and, by giving a reliable work of reference, facilitate and encourage the use of the microscope in the diagnosis of disease. I visited Dr. Peyer, and induced him to prepare fifteen additional plates, which would about complete the book for its purposes.

I hope, in this shape, it will prove a useful addition to the library of our practitioners.

A. C. GIRARD.

Fort Porter, Buffalo, N. Y., *March, 1885.*

PREFACE.

After five years' attention to a considerable practice I determined on revisiting the university in order to fill certain gaps in my knowledge. While engaged in the practice of medicine I had recognized the necessity for a physician to become familiar with the microscope, if he made any pretension to scientific treatment.

One of my friends, assistant professor at the university, with whom I frequently used the microscope, advised me always to draw my microscopic preparations, because it instilled the habit of more carefully observing. In pursuance of this advice, I first drew on single sheets; later on I kept a book for the purpose.

On my return to my professional labors I continued this drawing, which had become a pleasant habit, and in a few years I obtained thus a collection of four hundred microscopical drawings, representing principally investigations on urine, expectoration, intestinal contents, blood, etc.

The book which I am now publishing under the name "Microscopie am Krankenbette" had thus its origin without any definite plan. Many of my preparations were new to me, and I was the more particular in making a faithful drawing. For instance, I had long drawn the crystals in the sputum of asthma, and the so-called testicle-cylinders, before learning that others had observed them.

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of the urethra, bladder, and kidneys, and to "spermatorrhœa," a chapter which has thus far received but little attention microscopically.

It is a disease which can be diagnosed positively by means of the microscope. It is more frequent than is usually imagined (as I have demonstrated by thousands of examinations), and of greater practical importance. I am not speaking of those cases where, in consequence of difficult defecation, a few spermatozoids appear in the urine, or where, after exhausting diseases, some sperma might be found in the same, but of the cases, by no means rare, of independent origin, more or less severe, which have been overlooked even by eminent physicians, if a *repeated* and careful examination has not been made.

This work being intended principally as a microscopic atlas, I have made the text as short as possible, mentioning only what has to be borne in mind by the physician. He can thus find his way rapidly, without constant necessity of reference to special works.

The fourth chapter, treating of the microscopic examination of the sputum, is much simpler, and therefore restricted in space. Even here it had not been of great importance in the diagnosis of disease until very lately. It had been considered as an aid in diagnosis, and the most important part was the demonstration of the elastic fibers, either confirming the diagnosis made by auscultation or percussion, or permitting the detection of phthisis at a time when physical signs were still absent, or by the appearance of elastic fibers in the sputum, rendering a differential diagnosis possible between putrid bronchitis and pulmonary gangrene.

The status of microscopic examination of the expectoration has, however, been altered since *Koch* discovered the tubercle bacillus. Every well-educated physician must know it, and be able to discover it. It is no more an adjuvant of physical examination, but has conquered an independent, or even first rank.

Microscopic examination of the stool has least been practiced by physicians, for obvious reasons; this part of practical microscopy has even been neglected in many clinics. Surely this is a mistake, for the examination is very feasible, and may at times be of practical importance. It enables us, for example, to draw conclusions as to the digestive ability of the stomach and intestines for certain substances, and to direct the diet accordingly. Particularly, however, we should consider it a duty to make this examination in all cases of chronic diarrhœa, especially where the etiology is uncertain. There are cases where liquid discharges are induced by parasites, a condition which can only be diagnosed with the microscope.

The principal animal parasites of the intestine have been added for the sake of completeness and convenience, although their diagnosis and differential diagnosis can be established without the microscope. I owe the text of this chapter, and a number of preparations, to the kindness of my friend, Dr. Vogler, our authority here in medical zoölogy, to whom I herewith express my thanks.

I have given the power used only in those cases where it is of importance, and may here state, in general, that the larger crystals are represented with weak power; the small objects, however, are magnified with Hartnack 7 or 9.

Finally, I desire to express my acknowledgments to my colleagues who have assisted me with interesting preparations.

DR. ALEX. PEYER.

SCHAFFHAUSEN ON THE RHINE, *March, 1885.*

(*Preface supplied for this edition.*—TRANSLATOR.)

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I was confirmed in my resolution to publish my drawings in their present shape mainly by the consciousness that their origin represented, more than any other book of the same character, the wishes and needs of the practitioner.

All the plates, with the exception of No. 90 (copied from Friedländer), and a few small squares in Plate 83, on examination of blood, are original drawings. Most of them will sooner or later come under the observation of the physician who is tolerably proficient with the microscope.

I consider my insisting on the word *original* not unimportant, because we have on uroscopy, for example, but one good atlas, that of Ultzmann and Hofmann, and the majority of drawings in chemical works are borrowed.

The book consists of seven parts:

I. Microscopic Examination of the Blood.
II. Microscopic Examination of the Mammary Secretion.
III. Examination of the Urine.
IV. Microscopic Examination of the Sputum.
V. Microscopic Examination of Intestinal Contents.
VI. Microscopic Examination of Contents of Stomach.
VII. Microscopy of Fluid Contents of the various Abdominal Tumors.
VIII. Microscopy of the Secretion of the Female Sexual Organs.
IX. Various Micro-Organisms provoking Disease.

Concerning the microscopy of the urine, I have only represented sediments occurring in a *natural* state, leaving out the artificial production of several constituents, such as urea, uric acid, etc., these being of less importance to the physician than to the physiologist and chemist.

I have, however, given much attention to the various diseases

of the urethra, bladder, and kidneys, and to "spermatorrhœa," a chapter which has thus far received but little attention microscopically.

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V.—*MICROSCOPY OF THE STOOL.*

VI.—*MICROSCOPY OF CONTENTS OF STOMACH.*

VII.—*MICROSCOPY OF FLUID OF ABDOMINAL TUMORS.*

VIII.—*MICROSCOPY OF THE SECRETION OF THE FEMALE SEXUAL ORGANS.*

IX.—*VARIOUS MICRO-ORGANISMS PROVOKING DISEASE.*

CHAPTER I.

MICROSCOPIC EXAMINATION OF THE BLOOD.

PLATES 1–3.

MICROSCOPY OF THE BLOOD.

We know very little of the changes taking place in blood during disease, although its part is physiologically and pathologically a very important one. Microscopy of the blood gives us the most information of all the methods of examination.

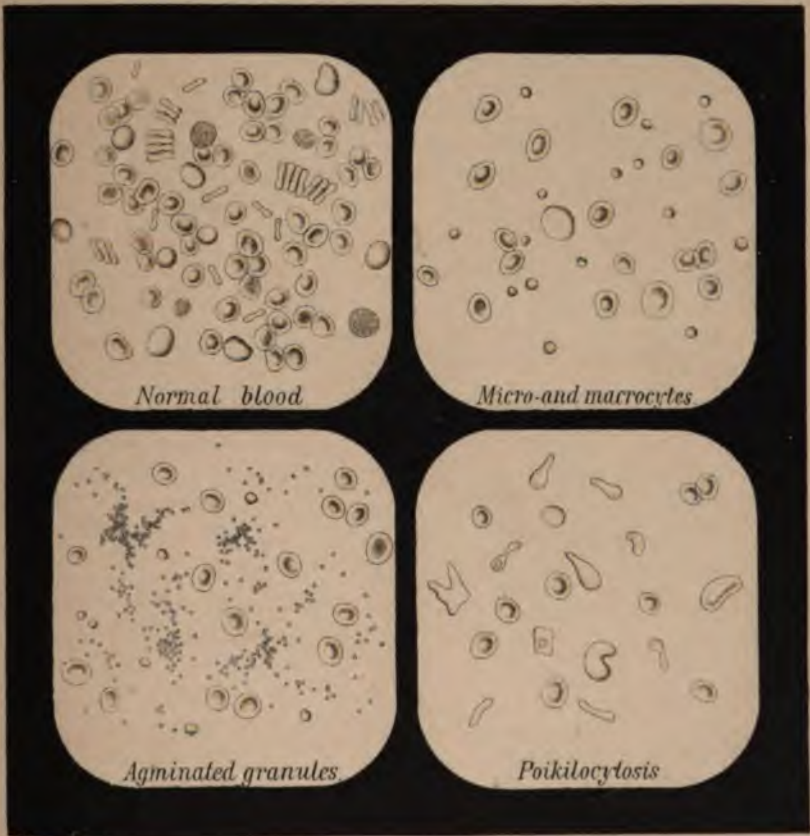
The following is the mode of preparation: After carefully cleaning the skin, a puncture is made with a needle which first has been disinfected by fire and the first drop of blood wiped off. The second drop only—and it must not be larger than the head of a pin—is caught and covered. The disk-shaped red blood-corpuscles, the transparent plasma, and the rare white corpuscles can now be recognized at once if the layer of fluid is thin enough.

Normal Blood.—The total quantity of blood is estimated at one third of the weight of the body. Its reaction is alkaline, its taste saline, owing to the salts held in solution. Fresh blood always exhales a peculiar odor—*habitus sanguinis*—which is due to volatile fatty acids.

The *Red Blood-Corpuscles* are circular, homogeneous disks, with central depression on both faces. Their average diameter is 7·7 μ. A cubic millimetre contains about five millions of them. They consist of a frame—stroma—with a pale, soft protoplasm, and the hæmoglobine, which is diffused through the stroma. We frequently find the blood-corpuscles, after being discharged from the body, to unite into the shape of rolls of coin, "*rouleaux.*"

White Blood-Corpuscles.—The blood contains also a number of cells which have penetrated from the outside—the white blood-corpuscles, leucocytes, lymphoid cells. They consist of a soft, movable protoplasm without shell. In fresh condition they show no nuclei. These appear only after the addition of water or acetic acid, from 1 to 4 in number. The relative quantity of leucocytes to the red corpuscles is as 1 to 300. Their number is less after leaving the circulation, because many of them perish during the process of coagulation.

PLATE 1.

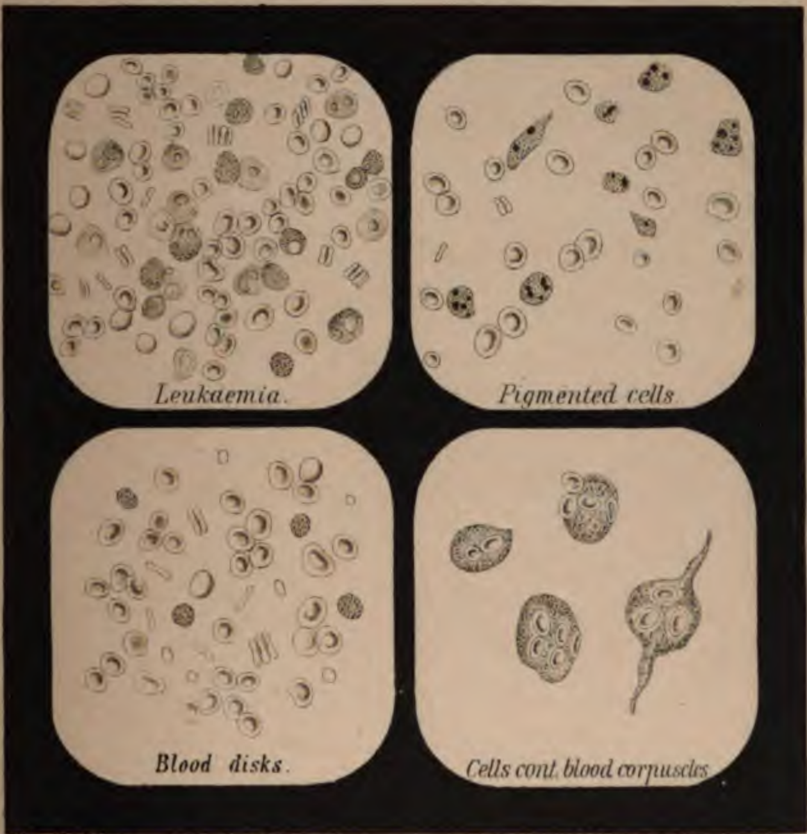


Mezger lith.

Examination of blood.

Peyer's microscopy.

PLATE 2.



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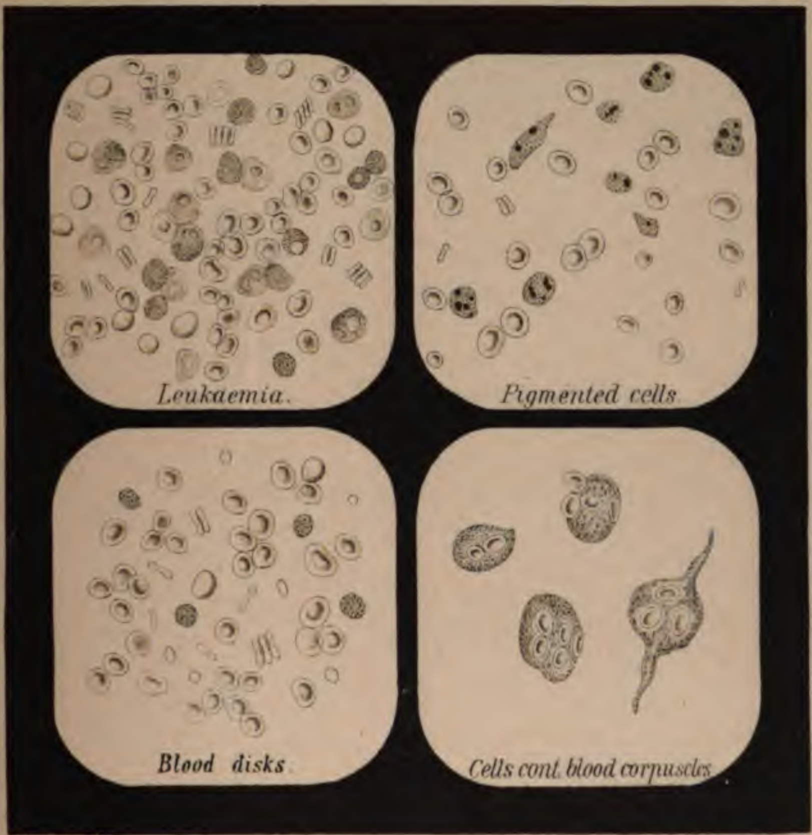


Mezger lith.

Examination of blood.

Peyer's microscopy.

PLATE 3

Mezger lith.

Examination of blood.

Peyer's microscopy.

Microcytes and Macrocytes.—The microcytes are exceedingly small, biconcave red blood-corpuscles, which occasionally are found in the blood of anæmic or hydræmic persons. They are probably a result of disintegration. The macrocytes or giant blood-cells occur generally where the microcytes are found; the reason of their existence is not known, but they act as a kind of compensation for the microcytes.

Agminated Granules are also found in normal blood. They are small, round, or angular protoplasm-particles, which are mainly found in anæmic and cachectic conditions. They are supposed to be the result of disintegration of red blood-corpuscles.

Poikilocytosis is the name for a condition of the blood showing unusual richness in modification of the red blood-corpuscles. They resemble biscuits or anvils, even up to almost total bipartition. This peculiar appearance was first observed in pernicious anæmia, and has been considered as characteristic of the same. This view has been abandoned of late, because the same change was found in other diseases—e. g., Addison's disease.

Leucœmia.—We have mentioned above that in normal blood the relative number of leucocytes to the red corpuscles is as 1 to 300. In the disease, however, which we call leucæmia, the number of the former is largely increased, the latter diminished. Leucæmic blood is characterized in all advanced cases by its pallor and fluidity; it appears as if mixed with milk. This real leucæmia is rather rare, and we find more frequently a *temporary* increase of the white blood-globules, the so-called leucocytosis. It is usually a result of zymotic diseases, and the relative proportions may be as 1 : 50–100.

Melanœmia is a condition where we find dark pigment-scales either floating free in the blood or inclosed by the amœboid movements of the white blood-corpuscles. These scales appear at the same time in the substance of the spleen, liver, brain, and spinal cord. They are probably liberated by the disintegration of the red blood-globules, as in marsh-fever, etc.

Blood Disklets.—Bizzozero demonstrated with very high power that very pale, colorless, disk or lentil-shaped, oval or circular disklets may be found in the smaller mesenteric vessels of various mammals in addition to the blood-corpuscles. They can be also

observed in blood discharged from the vessels, between the leucocytes or in the upper strata of the fluid. The agminated granules are supposed to be the result of their disintegration. They are said to play an important part in coagulation, of which they seem to form the initial stage. Bizzozero observed them increased in certain diseases. They are demonstrated in the following manner: A drop of a solution of methyl violet (1 to 5,000) is placed upon a punctured wound of the finger and mixed with the blood, which is then brought under the microscope.

Cells containing Blood-Corpuscles.—Lately larger bodies of protoplasm have been demonstrated in the blood. They are said to be large lymph-cells, which, by amœboid movement, have surrounded red blood-corpuscles. These cells are supposed to hail from the spleen, and this probable origin has been used as a proof that the spleen is the organ which absorbs the red blood-corpuscles. *Eichhorst*, from whom my drawing is copied, observed them not infrequently in abdominal typhoid.

Crystals of Hæmatoïdin are found everywhere in the body in blood stagnating outside the circulation and disintegrating—e. g., in cerebral hæmorrhage—further in thrombus, and regularly in each Graafian follicle, as a drop of blood is exuded on the bursting of the vesicle. Hæmatoïdin crystallizes in clinorhombic prisms.

Crystals of Hæmin were first developed by *Teichmann* from the coloring-matter of blood. They are of the greatest importance for the recognition of blood, be it in red stains or dissolved in fluid. They therefore play an important part in forensic medicine. They are brown, in various shades, and have the shape of small rhombic tablets or rods. At times they have the form of hempseed, shuttles, or section signs. The crystalline form of hæmin is identical in all kinds of blood.

To extract hæmin crystals from blood-spots, we place a few particles of the dried blood on a slide, add two or three drops of glacial acetic acid and a minimal grain of salt. The cover-glass is now applied carefully, and the slide is held over an alcohol flame at considerable distance until a few vesicles are formed.

Parasites of the Blood.—Thus far only two parasites have positively been determined, although there is a tendency to explain

the origin of all zymotic diseases as due to immigration of such beings. These two are the *Bacillus anthracis* and the *Spirochæta recurrentis.*

The following method of demonstration is practiced by *Ehrlich:* A drop of blood is spread on an objective and allowed to dry. Some methyl-blue solution is then added to it and allowed to act upon it twelve to twenty-four hours, and is then washed off with a gentle stream of water. The preparation is now exposed to dry again. The bacteria are easily recognized by their more intense coloring, while the blood-corpuscles are but slightly altered. We must not always expect to find microbes in zymotic diseases, as they may be accumulated in one of the organs and not circulate in the blood.

The *Bacillus anthracis* appears as a globular or rod-shaped bacterium. The rods reach a length of two to twelve μ, and are composed of minute globular cells.

The *Spirochæta recurrentis* has been discovered by *Obermeier;* it is found constantly in the blood in recurrens, and is a delicate rod progressing with corkscrew motion.

CHAPTER II.

MICROSCOPIC EXAMINATION OF THE MILK.

PLATE 4.

MICROSCOPIC EXAMINATION OF THE MAMMARY SECRETION.

In the third and fourth months of pregnancy we can already, with slight pressure, cause from the mammary gland the flow of a fluid, the so-called *colostrum*, which after birth assumes the characteristics of milk.

Colostrum contains morphologically the following parts:

1. Principally the *colostrum-corpuscles*, the origin of which is not yet determined.

2. The *milk* or *butter globules;* they are fat-drops of varied size and relative number.

3. *Leucocytes*, occurring in small numbers only in normal milk.

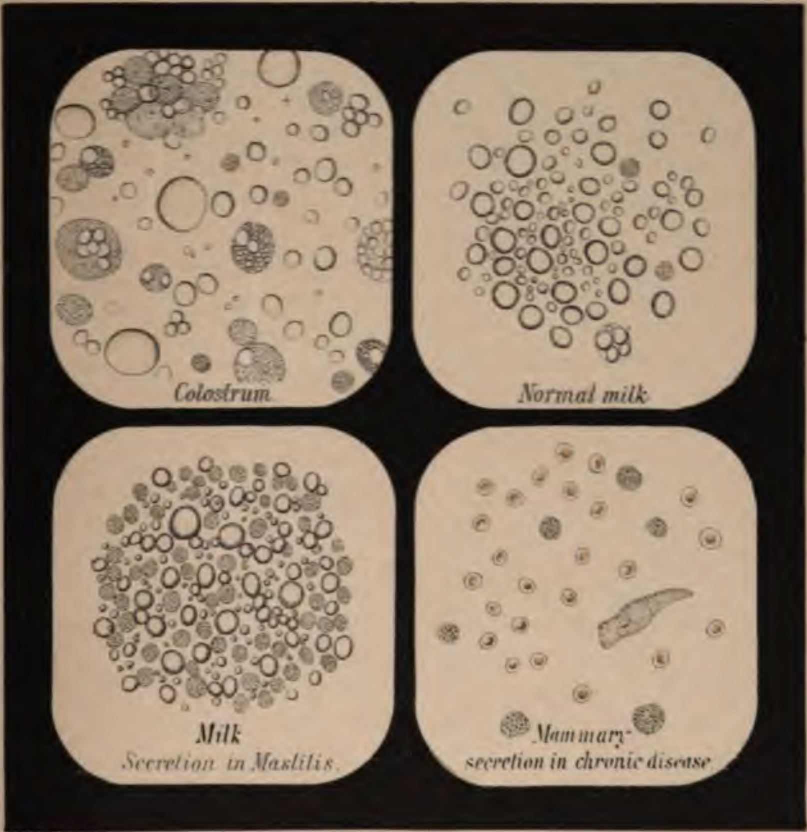
The colostrum-cells disappear gradually about the third day after parturition, when the milk secretion has reached its acme, and have entirely vanished on the tenth day. The milk-globules are then the only form element, aside of the leucocytes, which are still present in small numbers; these may increase greatly in consequence of inflammation of the mamma during lactation.

We find occasionally that the milk, without apparent cause, is, during lactation, transformed again into a colostrum-like fluid; neither the macroscopic appearance nor the quantity are changed, and the microscope is alone able to give us the reason of the decline of the infant (Donné).

It is well known that the mammary gland may secrete a fluid of colostrum appearance without existence of gravidity, even after the climacterium, especially in case of formation of neoplasms, but even without them.

I observed for a number of years a peculiar secretion of the mamma in a woman who had long ceased menstruating. From time to time, day and night, a drop of glutinous, alkaline fluid exuded from the right nipple, staining the linen. Pressure would cause oozing of several drops. The microscope revealed only a few leucocytes, but large numbers of red blood-corpuscles. Neo-

PLATE 4.



Mezger lith.

Examination of milk.

Peyer's microscopy.

plasm could be excluded. At times this secretion became so abundant that the woman had to cover the breast with cotton wadding, which had to be changed repeatedly during the day.

Tuberculosis of Milk.—This was a fact of great interest for physicians years before the discovery of the tubercle bacilli, it having been observed several times that the milk of tubercular cows induced phthisis in the human being. The view expressed then, that milk may be the bearer of tuberculosis, has been confirmed by the discovery of the *tubercle bacillus*, which has also been demonstrated in the milk.

CHAPTER III.

EXAMINATION OF THE URINE.

PLATES 5–67.

URINE.

GENERAL CHARACTER OF THE URINE.

QUANTITY OF THE URINE.

The mean quantity in twenty-four hours is forty to fifty-six fluidounces (1,200 to 1,600 cb. cm.). The quantity of water secreted by the kidneys equals about that evacuated by skin, lungs, and fæces together.

The greatest hourly amount is in the afternoon, the smallest during the night, the mean during the morning hours.

SPECIFIC GRAVITY AND SOLID ELEMENTS.

The average specific gravity of normal urine is from 1·015 to 1·025. But the healthy urine may lose in specific gravity after excessive drinking of water and drop as low as 1·002, while after great bodily exertion with considerable perspiration it may rise to 1·035 to 1·040.

Sugar is pathologically the principal cause of increase in specific gravity. We can with great probability diagnose diabetes with the urinometer alone, without chemical analysis, when the weight of a pale, abundant urine exceeds the normal one. Albumen has barely any influence on the specific gravity; it seems even to induce a diminution, as frequently urine very rich in albumen exhibits a very low specific gravity. The reason for this peculiarity is that usually in abundant chronic albuminuria the quantity of urea is diminished, which is decisive for the specific gravity; for in twenty-four hours the quantity of solids secreted is one to two ounces, of which one to one and a half ounce is represented by urea, and half an ounce by the chlorides; their relative quantity is as 2 to 1.

This proves the maxim that urine is really nothing but a solution of urea and sodium chloride, with which are mixed in smaller quantities certain organic and inorganic substances, constituents of the blood which have become unserviceable.

Specific gravity is raised (thus sometimes leading to error) by the use of potassium and sodium nitrates.

COLOR.

The normal color is a saturated yellow. It almost constantly goes *pari passu* with the specific gravity, a urine of low gravity being pale while that of high gravity is dark, or, as we call it, "high-colored." The only exception is made by diabetic urine.

The urine is nearly *colorless* especially in neuroses, "urina spastica." It can scarcely be distinguished from water in appearance.

It is *pale yellow* in all cases where the quantity secreted is increased.

Concentrated urine after copious meals, bodily exercise with strong perspiration, with little beverage, is *dark yellow* up to *reddish brown;* it usually shows a sediment on cooling.

When the color is *reddish* in consequence of the admixture of coloring matter from the blood, it often eventually turns dark brown, even black.

Mixture with bile-pigment turns the urine *yellowish brown.*

Decomposed urine with alkaline reaction appears of a *dirty blue*, with simultaneous secretion of indigo in the form of a blue film of crystals.

After use of senna, rhubarb, and also santonine, the urine turns *blood-red* and *reddish brown.*

Urine usually turns darker on standing, which is not the case when air is excluded.

REACTION.

Normal urine is acid; it is not determined yet which acid causes this reaction. Very acid condition of the urine is important for the physician, because it favors the formation of sediments or concretions, and thereby may cause irritation of the kidneys and urinary channels.

The acidity can be increased by ingestion of free acids, organic as well as inorganic. It will become temporarily neutral or alkaline by the use of potassium carbonate, also by lime and magnesia.

A temporary alkaline reaction takes place after excessive eating. This reaction has been explained as resulting from a copious secretion of muriatic acid at the beginning of digestion, thereby neutralizing the blood to such an extent that even alkaline urine is discharged. As during the further progress of digestion the muriatic acid is absorbed with the peptones, the urine turns again acid.

The "amphoteric" reaction, where the urine colors red litmus-paper pale blue, and blue paper pale red, has not been sufficiently explained as yet, and is of no symptomatic value.

TRANSPARENCY.

Normal urine, freshly passed, is usually clear and transparent; after standing some time, it turns slightly cloudy, the result of vesical mucus.

Pathological urine can be made turbid by all those substances which, after standing for some time, can be found in the sediments. Normal urine sometimes shows a whitish fluorescence, without our being able to tell the cause.

Alkaline urine appears greenish on reflected, yellowish red on transmitted light.

ODOR.

Normal urine, before cooling, is not of a disagreeable aromatic odor. This gradually disappears, and acid urine develops another odor. No definite chemical substances have so far been identified as causing the odor of urine.

A distinct ammonia smell can be recognized as soon as urine has passed into the alkaline fermentation.

The odor of urine is considerably altered by the use of certain kinds of food and medicaments, as asparagus, cauliflower, turpentine, balsam of copaiba, etc.

From a diagnostic point of view, it is not unimportant to remark that when these odorous substances do not pass into the kidney, a diseased condition of the whole texture of the kidneys exists.

URINE OUTSIDE THE ORGANISM.

After being passed and kept in a cool place, the urine frequently suffers a loss of acidity by precipitation of the uric acid, but sometimes it will turn more acid, and may remain so for eight to ten days. This acid reaction is accompanied by the formation of peculiar fungi, and by the separation of its sodium urate, uric acid, and calcium oxalate. Lactic acid is formed thereby, and is said to originate from very small quantities of sugar which occur in normal urine; for, in the presence of nitrogenous substances, small quantities of sugar will not undergo alkaline fermentation, but that of lactic acid.

The usual status, however, is that the original proportion of acid remains unchanged for some time; then it diminishes, the reaction turns neutral, finally alkaline.

ALKALINE FERMENTATION OF URINE.

After standing for some time, the urine passes from acid fermentation into alkaline by a decomposition of urea into ammonia carbonate.

During the transition it may happen that the ammonia which is formed is unequally distributed, so that certain parts have turned alkaline while others are still acid. Thus the possibility is explained that on the surface of a still acid urine a fine film of crystalline triple phosphate is being formed corresponding to the alkaline condition of this upper layer, while the lower parts still remain acid.

This change can already occur in the bladder in disease of the mucous membrane and presence of bacteria, especially in vesical catarrh.

If the urine is alkaline, it will become turbid by the separation of combinations which are insoluble in alkaline urine, such as earthy phosphates, triple phosphates, and ammonia urate.

The occurrence of alkaline fermentation depends on the access of bacteria to the urine, for acid urine can be kept from decomposition *ad libitum* if it is boiled for some time in a glass vessel, the neck of which is drawn out thin and fused during the boiling.

But urine may be passed alkaline without such fermentation in consequence of its contents of fixed alkalies by medication, etc. It is easy to detect by the odor if this reaction depends on fixed alkalies or on ammonia carbonate. Chemically, this is demonstrated by covering the vessel and fastening in the cover a piece of red or violet litmus-paper, so that it protrudes into the glass without touching the fluid. It remains red if the alkaline reaction depends on fixed alkalies, and turns blue if it is caused by ammonia carbonate.

CHEMICAL COMPOSITION OF URINE.

Urine is destined to remove from the body those products which originate in the disintegration of albumen. To this are added the salts which are liberated by the decomposition of the tissues; for of this albumen and the salts but very small quantities leave the body through the *intestine*, and of the products of decomposition carbonic acid alone appears in respiration. The products of decomposition of the carbohydrates and fat, however, do not pass into the urine, but are oxidated into carbonic acid and water.

THE NORMAL CONSTITUENTS OF URINE ARE:

1. Urea.
2. Uric acid. (Plates 7, 8, 9, 10, 11.)
3. Pigments. (Plate 23.)
4. Chlorides.
5. Phosphates.
   - Neutral calcium phosphate. (Plates 15 and 16.)
   - Sodium phosphate.
   - Calcium phosphate. } Earthy phosphates.
   - Magnes. phosphate. } (Plate 17.)
   - Ammon. magnes. phosphate. (Plates 17, 18, 19.)
6. Sulphates. (Plate 14.)
7. Oxalic acid. (Plate 12.)
8. Hippuric acid. (Plate 13.)

These substances shall be discussed, with the description of the plates, with the exception of urea, creatinin, and the chlorides, of

which, for the sake of completeness, we shall here communicate the most important points.

Other substances, as allantoin, xanthin, phenol, and hydrochinon, occur in the urine in very small and varied proportions. So far they have no diagnostic value, and are therefore of such inferior importance for the practicing physician that we shall not dwell on them.

UREA.

In earlier times urine was called a solution of urea and sodium chloride, and thereby the importance of urea as the principal constituent of urine was recognized.

Adults secrete thirty to forty grammes (seven to eleven drachms) daily.

It is formed in the blood from nitrogenous substances which had become effete, also from those in excess; it is the last product of the oxidation of human tissues containing nitrogen. Urea is also found in normal blood, sweat, and saliva.

It appears in all the animal liquids when the activity of the kidneys is suppressed. The secretion of urea is increased in all febrile diseases; further, in diabetes mellitus and preponderance of animal food. It is diminished in low diet and vegetable food; further, in parenchymatous disease of the kidney, especially before the appearance of uræmia.

In order to determine the quantity of urea it is sufficient for the practicing physician to add to concentrated urine an excess of pure concentrated nitric acid, and to weigh the separated crystals of urea nitrate. Albumen must first be removed.

CHLORIDES.

The quantity of chlorine secreted in the normal urine in twenty-four hours is ten grammes (two and a half drachms), representing about seventeen grammes (four and a half drachms) of sodium chloride. It is increased by bodily exertion, lessened during rest. Its secretion in healthy persons is further augmented by all those agents which are followed by an increase of urinary secretion. It also depends on the amount of salt taken with food.

It was first shown in pneumonia that the quantity of chloride diminishes considerably in acute febrile diseases.

In chronic disease it is usually parallel with the general nutrition of the body and the quantity of urine.

In diseases of the kidneys and in the formation of serous effusion into the cavities of the body it is diminished. In these cases it is simply a retention, for, on increase of the quantity of urine by the use of diuretics, the chlorides increase also.

The chlorides are easily demonstrated by nitric acid. To this effect the urine has first to be freed of albumen and mixed with a few drops of pure nitric acid. Then a few drops of a one-per-cent solution of nitrate of silver are added. A milky turbidity or flocculent white sediment of silver chloride results in direct proportion to the quantity of chlorides. It can thus easily be ascertained if the chlorides are absent, if they are increased or decreased, even if the whole deposit does not exclusively consist of silver chloride.

CREATININE.

Creatinine is also a constant constituent of urine, its average daily quantity being 0·6 to 1·3 gramme (9 to 20 grains). The more animal food preponderates, the greater the quantity of creatinine.

ABNORMAL CONSTITUENTS OF URINE.

1. ALBUMEN.

Filtered urine is boiled; it then shows a turbidity, when albumen is present, which gradually increases from above downward. On cooling, little clouds of coagulated albumen separate. This reaction may deceive; for when the earthy phosphates are present in copious quantity they are also separated by boiling, the carbonic acid of the urine which assisted in their solution being removed thereby. A few drops of acetic acid will dissipate this turbidity.

In order to prevent the separation of the earthy phosphates and thereby a possibility of mistake, it is best at the start to add a few drops of acetic acid. But if too much acid is added, then the albumen reaction itself is also destroyed, the serum albumen being con-

verted into acid albumen, which does not coagulate on boiling. An excess of acid is corrected by the addition of equal parts of a saturated solution of sodium sulphate, and boiling.

NITRIC-ACID TEST.

Pure concentrated nitric acid is poured below the filtered urine by letting it run down slowly along the walls of the obliquely held test-tube. The acid, being of greater specific gravity, sinks below the urine, and at the place of contact of both fluids a sharp ring of coagulated albumen is formed.

Urates may also form this ring, but it vanishes gradually upward, while in albumen both sides are sharply defined.

Lately a new test was indicated by Dr. Oliver, which is particularly suited for an examination at the bedside.

Two slips of paper, one impregnated with citric acid, the other with potassio-iodide of mercury, are dipped at the same time into a small portion of urine which is to be examined. When albumen is present (even in traces) it immediately is deposited as a white sediment.

2. SUGAR.

Grape-sugar in normal condition of the organism being present only in small quantities in the urine, an increased secretion of the same is the symptom of a grave malady, "diabetes mellitus."

The urine in this disease is voided in very large quantities, as much as 10,000 cubic centimetres being secreted in twenty-four hours. In spite of this large quantity, its specific gravity is the very highest—viz., 1·030 to 1·040. As a rule, the quantity of nitrogenous components is increased.

1. *Böttcher's Test.*—Urine and sodium carbonate are mixed in equal parts; a point of a knife full of subcarbonate of bismuth is added and heat applied. In the presence of sugar, bismuth is reduced and turns black. The solution of sodium employed must be made from the crystallized form in the proportion of 1 to 3.

2. *Trommer's Test.*—Two or three drops of a mixture of crystallized copper sulphate, 0·06 gramme (one grain), and 30·6 grammes (one ounce) of glycerin, with 15·0 grammes (half an

ounce) of liquor potassæ, are mixed and boiled. A few drops of urine are added and boiled. A brownish yellow oxide of copper is precipitated if sugar is present.

The presence of albumen does not interfere with this test.

MODE OF EXAMINATION OF URINE FOR THE PHYSICIAN.

First, the urine is allowed to stand a few hours in the vessel in which it has been brought, in order to see if a sediment will form. If after this the urine is still found to be turbid, it is filtered.

A test-tube is now filled two thirds with this clear urine and heat applied.

Should turbidity result, then its causes are either earthy phosphates or albumen. By addition of a few drops of acetic acid the phosphates are dissolved, but not the albumen.

In order to test at once for sugar, we add liquor potassæ in about half the quantity of the boiled urine. Albumen, if present, is dissolved, and the earthy phosphates separate in small flakes. We boil again. If sugar is present, the mixture will turn brown, and we will apply more accurate sugar-tests.

The microscopic examination of the *sediment*, which, aside from the chemical tests for albumen and sugar, is of most importance to the physician, is best carried out by allowing the urine to stand for some time in the vessel in which it has been brought, that the sediment may collect at the bottom; a pipette, the upper end of which is closed by the finger, is then introduced as far as the sediment to be examined. The finger is now raised slightly, and as much of the sediment as is wanted is allowed to enter by the pressure of the liquid. The closed tube is then drawn out and the sediment at once placed on the slide.

The urine has to be poured into funnel-shaped glasses only when a very scanty sediment is to be collected, as for cylinders in cirrhotic kidney.

It can not be sufficiently recommended to examine the urine in separate portions when suspicion of urethral disease exists, for the portion which is first voided and rinses the urethra exhibits frequently a picture very different from the second portion, which represents merely the contents of the bladder. The patient should,

therefore, pass at first a few spoonfuls of urine to cleanse the urethra, and this urine should be examined separately. In consequence of neglect of this precaution, diseases of the pelves of the kidneys and of the bladder have been diagnosed for an affection of the urethra.

SCHEME FOR URINARY EXAMINATION BY THE PRACTITIONER.

Quantity of urine in twenty-four hours:
Average frequency of urinating in twenty-four hours:
Color and transparency { (*a*) of the first portion:
{ (*b*) of the second portion:
Reaction:
Specific gravity:
Albumen:
Sugar:
Sediment:
  Abundant or slight:
  Color:
  Crystalline:
  In powder form:
  Flocculent or cloudy:
Elements of organized sediment:
  Mucus:
  Pus:
  Blood:
  Fungi:
  Epithelium:
  Cylinders:
  Spermatic parts:
  Accidental admixtures:
Total result:

MICROSCOPY OF URINARY SEDIMENTS.

PLATE 5.

ACCIDENTAL FOREIGN BODIES.

ACCIDENTAL FOREIGN BODIES.

Notwithstanding his request to have urine for examination brought to him in clean bottles, the physician will often have to distinguish accidental impurities from essential parts of the sediment.

As a rule, no great difficulty is experienced. We find principally:

1. Cotton fibers; they are very frequently found in the urine; in the table they are represented by the long threads crossing the visual field.
2. Air-bubbles of different sizes, easily recognized by their double sharp contour.
3. Fat-drops, varying from sizes discernible with the naked eye to the smallest forms, visible only with strong powers.
4. Amyloid grains, characterized by their concentric layers.
5. Feathers; slim shaft, with thinner ends and pointed barbs.
6. Fibers of silk.
7. Linen threads.
8. Trichomonas vaginalis. I observed this several times in the urine of women suffering from severe leucorrhœa. (See text of Plate 19.)

PLATE 5

Mezger lith.

Accidental foreign bodies.

Peyer's microscopy.

PLATE 6.

MUCUS IN THE URINE, FROM DIFFICULT STOOL.

PLATE 6.

MUCUS IN THE URINE, FROM DIFFICULT STOOL.

MUCUS IN URINE.

In normal urine, often a few hours after being voided, sometimes immediately afterward, we see little clouds, which after a time collect at the bottom of the vessel. Under the microscope these clouds reveal themselves as single epithelial cells, pus-cells, blood-corpuscles, and mucous coagula.

On an average this sediment is more considerable in the normal urine of the female than in that of the male, on account of the frequent additional admixture of pavement epithelium, blood- and pus-cells from the vagina.

This mucus, which can occur in very small quantities in normal urine, can be augmented considerably by various diseases of the genito-urinary system—for example, in catarrh of the bladder. The so-called gonorrhœal threads are also mucous coagula, in which pus-cells and epithelium are imbedded. In order to distinguish mucus chemically from albumen, we add to the cold urine acetic acid; mucus then separates in flakes. A turbidity resulting in clear urine from boiling is naturally a result of albumen, and not of mucus.

Microscopically, mucus presents itself in various pictures, depending on its origin. At times it appears as clear strips, which resemble hyaline cylinders and are made here and there opaque by deposit of sodium urate. With some practice the hyaline cylinders can easily be recognized by their distinct, regular outlines; they are never as broad as mucous threads, and do not branch out like the latter.

PLATE 6

Mezger lith.

Mucus in the urine from difficult stool.

Peyer's microscopy.

PLATES 7 AND 8.

URATES.

URATES.

They are a combination of the salts of potash and soda with uric acid. Generally the sediment consists of acid sodium urate. The urates form yellowish up to reddish-colored amorphous masses, with moss-shaped grouping; they have the peculiarity on separating from the urine to absorb coloring matter.

The great amount of urates, especially in fevers, often causes anxiety to the layman. Here the urates form the so-called sedimentum lateritium. Being more readily soluble in warm than in cold urine, they are precipitated from concentrated urine by mere cooling; they are found, therefore, as sediment principally after copious continued perspiration, such as we see in severe bodily exercise, and in acute articular rheumatism; further, in the crises of various diseases, when they are preceded by strong diaphoresis; lastly, in catarrh of the stomach and intestines, especially when it is combined with profuse diarrhœa and deficient absorption of water. The sediment of sodium urate is easily dissolved by heat; on cooling, however, it separates again; this peculiarity, as well as its coloring and acid reaction, confirm the diagnosis.

Sodium urate exists at times in the form of crystallized needles or lances arranged in form of a sheaf or rosette (Plate 8). I observed this form but once in the very acid urine of a young man who had suffered from enormous hæmorrhage of the stomach, and while kept in bed was placed upon milk and solution of meat.

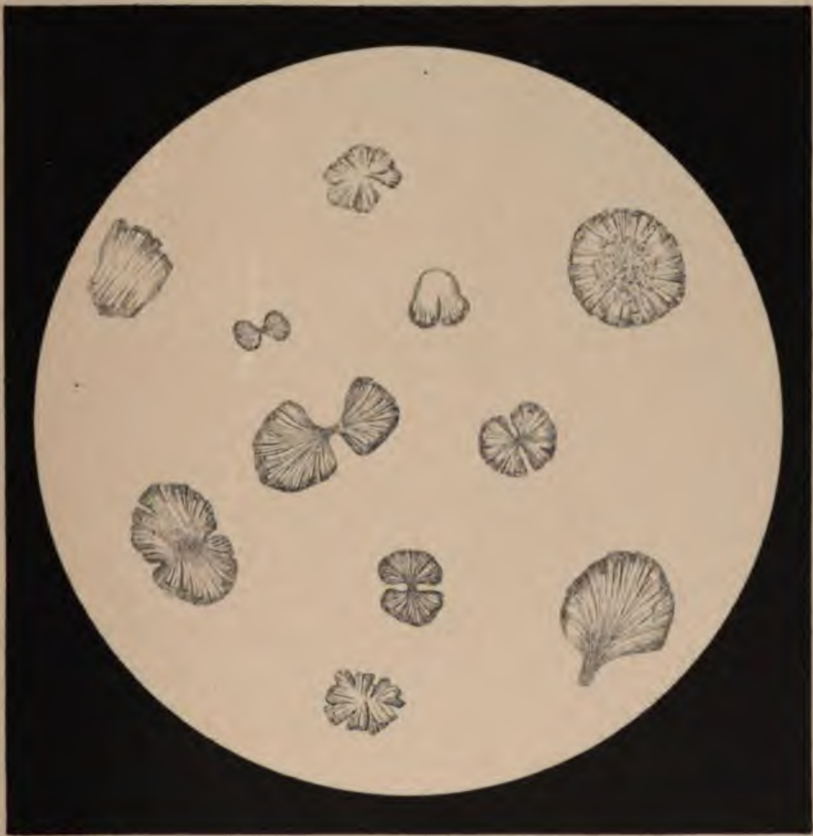
PLATE 7

Mezger lith.

Urates with uric acid crystals.

Peyer's microscopy.

PLATE 8



Mezger lith.

Sodium Urates.

Peyer's microscopy.

PLATES 9, 10, 11.

URIC ACID.

URIC ACID.

Uric acid is an unfinished urea; it can easily be converted into the latter by means of oxidation. In normal condition 0·5 gramme (about seven grains) of it are voided daily; its secretion is parallel to that of urea, with which it increases and decreases.

Its secretion is least in fasting and diet devoid of nitrogen. We observed increase:

1. In diet principally animal and want of open-air exercise.
2. In arthro-rheumatic diseases.
3. In acute febrile diseases, where considerable quantities of nitrogenous substances are consumed. Uric acid is frequently recognized with the naked eye as little red dots adhering to the walls of the vessel. Under the microscope the colors appear pale yellow to brownish red; this coloring is caused by the absorbed pigment.

The original forms are quadrilateral rhombic tables or hexagonal prisms, from which, by obtusion of the angles, other forms originate, such as spindle, barrel, and whetstone shapes.

In its *natural* condition we sometimes find it in the form of dumb-bells.

The best-known test is the murexide test. After being washed, the crystals are carefully heated with a few drops of concentrated nitric acid in a porcelain dish; the yellowish-red residue is colored purple by ammonia, blue by liquor potassæ.

In order to make a quantitative analysis, it is sufficient to add to one hundred cubic centimetres of urine five grammes (77 grains) of pure muriatic acid, to separate the precipitated crystals, wash them, and weigh them after drying.

PLATE 9

Mezger lith.

Uric acid.

Peyer's microscopy.

PLATE 10

Mezger lith.

Uric acid.

Peyer's microscopy.

PLATE 11

Mezger lith.

Uric acid in usual forms and as dumb bells.

Peyer's microscopy.

PLATE 12.

CALCIUM OXALATE.

CALCIUM OXALATE

Crystallizes in the shape of small, square octahedrons, which have great resemblance to envelopes. The crystals are brilliant and strongly refracting, by which they can be recognized, even when they are no larger than a point, as seen in the table.

It is insoluble in acetic but soluble in muriatic acid. This chemical peculiarity leads to their distinction from the crystals of ammonio-magnesian phosphates and calcium carbonates, which have a similar shape. In the animal organism oxalic acid occurs in very small quantities and always united with lime.

Formerly and again lately great importance has been ascribed to the excretion of oxalic acid; its increase was supposed to signify an abnormal direction in the change of tissues. This disease was described as "oxaluria." Oxalic acid belongs to the most constant excreta in the human urine, and it is probable that it belongs to the final products in the change of tissues.

We find it in increased quantity in urine when its natural production is augmented, or when the final oxidation of uric acid—the change of oxalic acid into carbonic acid and water—is not completed. In most cases the quantity of excretion of oxalic acid can only be determined by the microscope. Oxalate of lime being soluble in acid sodium phosphate, it depends mainly on the acidity of the urine if a deposit of calcium oxalate exists or not.

We may, therefore, find very few crystals of oxalate of lime in the sediment of a very acid urine, while it is really present in large quantities.

All we know of the connection of the excretion of oxalic acid in disease is that it exists in diabetes mellitus.

Cantani observed a regular alternation of sugar and oxalic acid.

Fürbringer demonstrated oxalic acid in the sputum of a diabetic.

Exclusive animal diet is said to cause its total disappearance, which, however, may be brought about by the greater acidity of the urine consequent upon such diet. I have been unable to confirm the frequent appearance of oxalate of lime in spermatorrhœa, which fact is mentioned by various authors.

PLATE 12

Mezger lith.

Calcium oxalate.

Peyer's microscopy.

PLATE 13.

HIPPURIC ACID.

HIPPURIC ACID

Is found in solution in every human urine, but appears only exceptionally crystallized in the sediment; generally it remains in solution.

The crystals have the form of fine needles or rhombic prisms or columns, the ends of which terminate in two or four surfaces.

We may be tempted sometimes to mistake these forms for uric acid or ammonio-magnesia. From the first mistake we are protected by the murexide test; from the latter by the fact that acetic acid does not affect hippuric crystals, while it dissolves the triple phosphates. We do not know anything positive as to a possible increase of hippuric acid in certain diseases. Generally it is augmented in healthy persons by abundant vegetable diet, and especially by the use of cranberries, plums, etc., which contain benzoic acid.

In the tropics larger excretion of hippuric acid has been observed.

PLATE 13

Mezger lith.

Hippuric acid.

Peyer's microscopy.

PLATE 14.

CRYSTALS OF GYPSUM (CALCIUM SULPHATE).

4

PLATE 14

Mezger lith

Crystals of calcium sulphate.

Peyer's microscopy.

PLATES 15 AND 16.

NEUTRAL CALCIUM PHOSPHATE.

PHOSPHORIC ACID AND ITS SALTS.

The average quantity of phosphoric acid excreted in twenty-four hours is two grammes (30 grains). It is combined with sodium in the form of sodium phosphate (alkaline phosphates), or with lime and magnesia (earthy phosphates).

These salts remain in solution so long as the urine is acid.

Generally the excretion of phosphoric acid is increased by the same causes which induce an increase of excretion of uric acid and chlorine, viz.: diabetes mellitus and meningitis. The amount of phosphoric acid in febrile diseases is usually diminished; also constantly and considerably in kidney diseases; further, in rhachitis, gout, and chronic rheumatism; finally, in chronic brain diseases.

The exact measurement of the excretion of phosphoric acid is rendered difficult by the fact that part of the phosphoric salts pass off with the stool.

NEUTRAL CALCIUM PHOSPHATE

Is generally considered a rare sediment. It usually appears in the form of handsome spear-shaped crystals, of which part are directed toward a common center (Table 15).

In rare cases the simple wedge-shaped crystals, by close apposition, form magnificent rosettes (Plate 16). Generally these crystals occur in the opalescent film which forms on slightly acid, neutral, or alkaline urine.

At times we find the calcium phosphate in the above-mentioned film aside of the wedge-shaped crystals in the form of scales, with irregular, straight, or curved edges.

It is easily dissolved by acetic acid.

PLATE 15

Mezger lith.

Neutral calcium phosphate.

Peyer's microscopy.

PLATE 16

Mezger lith.

Neutral calcium phosphate.

Peyer's microscopy.

PLATES 17, 18, 19.

EARTHY PHOSPHATES WITH TRIPLE PHOSPHATE.

THE EARTHY PHOSPHATES

Consist of calcium phosphate and magnesium phosphate. Being soluble in acid urine only, they are always precipitated in alkaline urine, and form a whitish sediment, which frequently is very considerable. They can be distinguished from the urates at once by the fact that the latter occur only in acid, the former only in alkaline urine. The urates are also always colored by absorbed coloring-matter.

The urates disappear on heating; the earthy phosphates increase, because the carbonic acid which mainly is necessary to their solution is driven out. Microscopically, they can easily be distinguished, the earthy phosphates not forming such beautiful moss-like structures, but being finer, more dust-like.

As in a sediment of urates a few uric acid crystals rapidly are forming, so we find likewise a few triple phosphates in a sediment of earthy phosphates.

TRIPLE PHOSPHATE; AMMONIO-MAGNESIUM PHOSPHATE.

Neutral calcium phosphate and magnesium phosphate, being soluble only in acid urine, are precipitated as soon as the urine turns alkaline in consequence of the formation of ammonium carbonate. Magnesium phosphate combines with the free ammonium and forms ammonio-magnesium phosphate. This is always distinctly crystalline. The original shape is a prism, similar to a coffin-cover, hence the name coffin-shaped crystals (Plate 17). But the most marked deviations and combinations occur, so different from the original forms that they can only be recognized by the transition formations—e. g., the fern-shaped crystals of Plate 19.

PLATE 17

Mezger lith

Earthy phosphates with coffin shaped crystals.

Peyer's microscopy.

PLATE 21

Mezger lith.

Ammonia urate.

Peyer's microscopy.

PLATE 18

Mezger lith.

Triple phosphates
(Coffin shaped crystals).

Peyer's microscopy.

PLATE 19

Mezger lith.

Triple phosphates.
(Ammonio-magnes phosphate).

Peyer's microscopy.

PLATES 20 AND 21.

AMMONIA URATE.

AMMONIA URATE.

It is demonstrated, beyond any doubt, that salts of ammonia are a constant element of urine; in the body they originate from the products of albumen. According to Schmiedeberg, the quantity of ammonium carbonate in the body is very considerable, and the urine contains only a small remnant, which has escaped the transformation into urea.

Its quantity depends on the amount of acid originating in the body or brought in from without. It has been demonstrated that after ingestion of acid in the dog the quantity of ammonia rises in the urine. Ammonia urate appears in the form of yellowish-brown globules; usually they are smooth, but at times they have points, which may attain considerable length, resembling a thorn-apple, spiked club, or an acarus. The thread of globules of ammonia urate traversing our picture is an accidental result obtained by the globules attaching themselves to a vegetable fiber.

The forms represented on Plate 21 are rare. They are oblong, grayish double globes, dumb-bells, resulting, no doubt, from an apposition of the globes.

PLATE 20

Mezger lith

Ammonia urate.

Peyer's microscopy.

PLATE 21

Mezger lith.

Ammonia urate.

Peyer's microscopy.

PLATE 22.

CALCIUM CARBONATE.

CALCIUM CARBONATE

Occurs in alkaline, rarely in neutral urine, in the form of small white globes, which are aggregated in a glandular form; dumb-bells occur rarely. The sediment effervesces on addition of mineral acids.

Lime is excreted in increased quantity, as a rule, in diabetes mellitus and phthisis; in fever there appears to be a diminution.

The urine of the herbivores contains a preponderance of calcium carbonate, and is therefore turbid on being voided.

PLATE 22

Mezger lith.

Calcium carbonate.

Peyer's microscopy.

PLATE 23.

THE PIGMENTS OF THE URINE.

THE PIGMENTS OF URINE.

Of all those mentioned above, only two are of importance to the practitioner, and they are the only ones which can be isolated. The first, *urobilin*, derives its origin probably from the bile-pigments, and occurs also in the fæces. The other, *indican*, is probably a result of the division of the albuminates. The color of urine is of diagnostic value, denoting, when high, always acute and febrile disease, while in all those co-existing with imperfect blood-production (chlorosis, nervous temperament, etc.) it is of a paler color.

ABNORMAL COLORING MATTER.

Uroërythrin is to be found in the urine of febrile patients, even in the slightest catarrh. Whenever urine contains this pigment it denotes disease. It colors the urine orange, which may be exaggerated to a deep blood-red. It is probable that in febrile diseases a part of the blood-corpuscles perishes, the coloring-matter of the blood thereby being altered, so as to leave the body in the form of uroërythrin.

Urine containing uroërythrin, dried on white paper, stains it pale brown and not yellow, like that containing bile-pigments.

It also causes, with a few drops of a solution of acetate of lead, a sediment from flesh to leather-brown color.

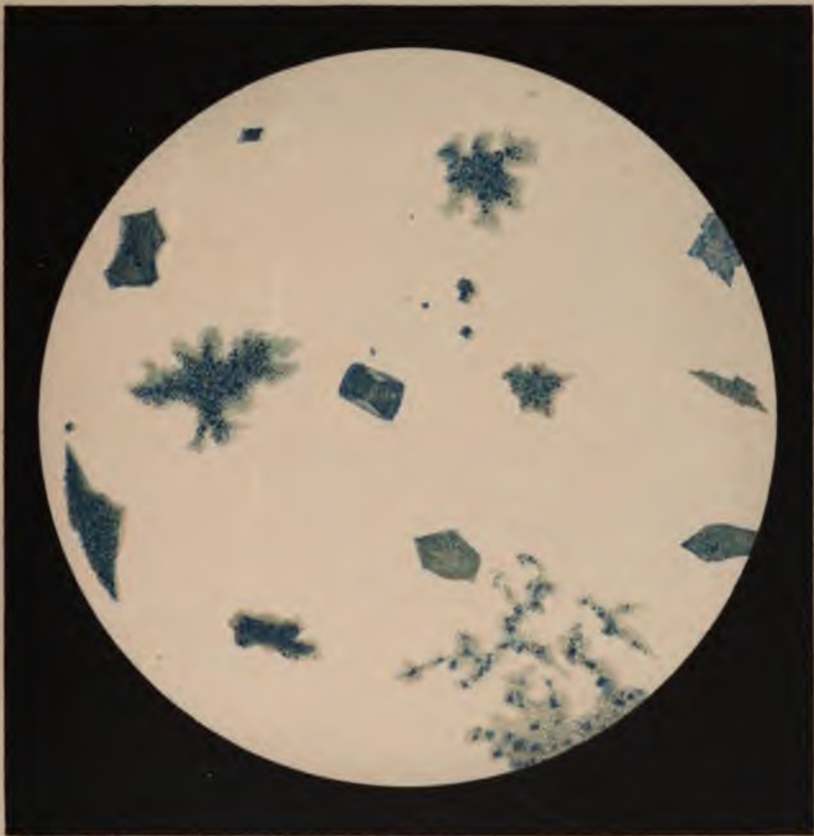
VEGETABLE-PIGMENTS (*Rhubarb and Senna-Leaves*)

Often communicate to the urine a deep-red color. In this case, the urine being alkaline, the color changes to yellow on addition of an acid, but on saturation with ammonia it recovers its red appearance.

BLOOD-PIGMENTS (*Hæmatin*).

As such we consider here only those which can be obtained by water and watery solution from the red blood-corpuscles, not their derivatives.

PLATE 23



Mezger lith.

Urine indigo, (Indican).

Peyer's microscopy.

So-called hæmatinuria—i. e., transition of the blood-pigment into urine—occurs only in general diseases, such as scurvy, purpura, scarlatina, etc.

Heller's Test.—Urine is slightly heated with equal volumes of potassium or sodium liquor; on being precipitated, the earthy phosphates carry with them the blood-pigment and appear red instead of white.

One or two drops of a fluid containing magnesia are added, when the urine is alkaline, or when, on heating, no earthy phosphates are deposited, because they had been precipitated previously. A sediment is caused thereby which, on heating, carries with it the blood-pigment as well as the earthy phosphates.

The delicacy of this test is scarcely inferior to the examination with the spectroscope. Bile-pigment and urinary coloring-matter do not affect the color of the sediment.

BILE-PIGMENTS (*Bilirubin and Biliverdin*).

Their discovery in urine is scarcely of diagnostic importance, the coloring of the conjunctiva being sufficient for that purpose.

The urine is yellowish brown, and foams considerably. Even the foam is yellowish.

Gmelin's Test.—Nitric acid is allowed slowly to run along the wall of the glass into the urine. (This nitric acid should contain traces of nitrous acid, which is attained by decomposition on contact with the atmosphere or by heating with sugar or immersion of a chip of wood.) A beautiful play of colors takes place at the point of contact; a green ring is formed, with a blue one at its under surface, then violet-red, then yellow.

The green color alone is characteristic for the bile-pigments.

Bile Indigo (*Indican*).—Small quantities of indican occur also in normal urine. It is increased by all affections of the small intestine which obstruct it—e. g., ileus, incarceration, etc. It is likewise augmented by ulcer and carcinoma of the stomach, by general consumptive diseases, and by phthisis with diarrhœa.

It is the cause of bluish coloring of the urine, or of the blue bodies in the sediment. It may be transformed into indigo-blue

when with increased excretion the urine is undergoing ammoniacal decomposition; it is then deposited spontaneously on the bottom of the vessel in the form of small rhombic or spear-shaped blue crystals, or coats the surface of the liquid as bluish film.

It is in rare instances already formed in the system, and the color of the urine is then blue.

PLATE 24.

LEUCIN AND TYROSIN.

LEUCIN AND TYROSIN

Do not occur in normal urine; we find them most frequently in acute yellow atrophy of the liver.

Tyrosin can be found in the sediment of such an icteric urine without further preparation, while, in order to demonstrate leucin microscopically, we have to inspissate the urine, extract with alcohol, and evaporate this latter again. Leucin appears in the form of plates of various sizes, and with a weak opalescence; tyrosin, in that of slender sheaves and rosettes.

Leucin is especially found in the glandular organs of the body, and, with tyrosin, is a constant product of the resolution of the albuminates and nitrogenous substances. Their recognition in the urine is mainly based on microscopic examination.

PLATE 24

Mezger lith.

Leucine and tyrosine.

Peyer's microscopy.

PLATE 25.

CYSTIN.

5

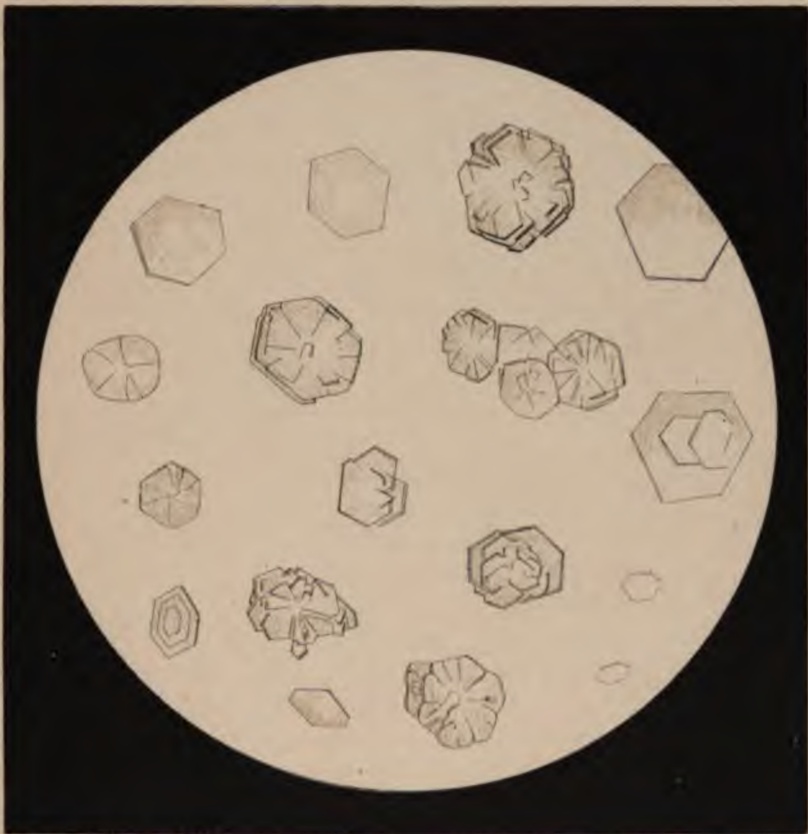
CYSTIN

Is not found in normal urine; only in the sediment, where cystin stones occur. Still, cystinuria may exceptionally exist without them. It crystallizes in the form of regular hexagonal tables, some of which are piled on each other. It may be distinguished from the similar tables of uric acid by its insolubility in muriatic acid.

Cystinuria is found more frequently in the male sex than in the female, mostly in earlier life, becoming more rare in advanced years. The excretion varies in degree, and may at times entirely cease. It has been ascertained that in a family generally several members suffered from the disease.

Our table represents the urine of a gentleman sixty years of age, who otherwise is a picture of health; he has suffered since his youth from cystinuria, with repeated passage of cystic stones under colicky pains. He has had no colics these five years, but several attacks of regular gout. Gout and nephritic stone are represented in this family for generations; several members also have passed cystin stones.

PLATE 25



Mezger lith.

Cystine.

Peyer's microscopy.

PLATE 26.

BLOOD- AND PUS-CORPUSCLES.

BLOOD- AND PUS-CORPUSCLES.

Blood-corpuscles appear under the microscope in the form of pale-red disks with a central shade. From the edge they look biscuit-shaped; at times we find thorn-apple shapes in absolutely normal urine. The blood-corpuscles remain unchanged for days in acid urine; in ammoniacal urine, however, they swell and the shade appears on the periphery; they assume now the shape of globes, turn gradually paler, until at last they represent only a shadow, which finally disappears.

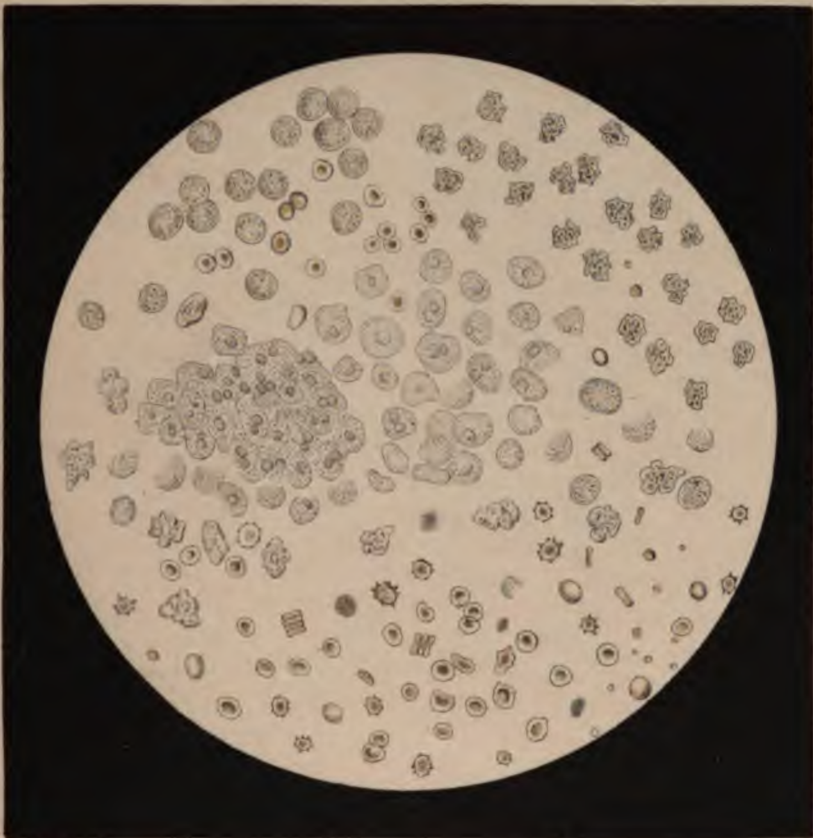
When blood in the body is for some time in contact with urine it loses its oxygen, and brown coloring replaces the red. Later on the reaction of urea occurs; the blood-corpuscles are disintegrated and form larger or smaller globular bodies; they may even become so small as to be dust-like. These bodies having been demonstrated also in the blood of persons suffering from various diseases, they have been named macrocytes and microcytes. They are characteristic of capillary hæmorrhages, because small quantities of blood are mixed here for a considerable length of time with the urine at the temperature of the human body. The blood-corpuscles appear as disks or in form of thorn-apple when the hæmorrhages are more considerable. Every urine containing blood is also albuminous.

Single *pus-corpuscles* occur almost in every urine, especially that of women. Their appearance in larger numbers is always a sign of acute or chronic inflammation in the genito-urinary system. Pus-corpuscles are of about twice the size of blood-corpuscles and of fine granular opacity. The nuclei are on that account not visible, but appear on addition of acetic acid. The corpuscles have at times a serrated form. They swell in ammoniacal urine and coalesce into a mass in which under the microscope only nuclei and pus-corpuscles in the stage of solution are recognizable.

Urine becomes albuminous also by the admixture of pus, although in a lesser degree, unless albuminuria is existing in addition.

How may the practitioner discern if the albuminous condition depends solely on the pus, or if in addition real albuminuria exists? The microscope is necessary to solve this question. An albumi-

PLATE 26



Mezger lith.

Blood and puscorpuscles.

Peyer's microscopy.

nous sediment, obtained by boiling, which appears to be one twentieth to one twenty-fifth of the volume of the urine, originated exclusively from pus, when each drop of the urine examined after shaking shows several pus-corpuscles.

The greater the quantity of albumen the greater should be the number of pus-corpuscles under the microscope. A simultaneous nephritis must be thought of when the number of pus-corpuscles is not corresponding to the quantity of the albumen. The pus-corpuscles can only be confounded with yeast-cells, but the latter do not show any granulation; neither does the addition of acetic acid cause the appearance of nuclei. Donné's pus-test is also without result. Pus-corpuscles, brought freshly under the microscope, present, especially in vesical catarrh, an amœboid motion, and appear in various figures. On dying they again assume the well-known round shape. In icteric urine they are stained yellow more or less.

PLATES 27, 28, 29.

EPITHELIAL CYLINDERS AND MIXED CYLINDERS.—HYALINE CYLINDERS.—FINELY GRANULATED CYLINDERS.

KIDNEY CYLINDERS.

Their origin is various. Those that are dark and granular may be produced directly by coalescence of degenerated epithelial cells.

Hyaline cylinders, however, are probably caused by coagulation of an albuminous body contained in the urine.

The presence of hyaline cylinders is not always an evidence of diseased kidney. Thus we find, e. g., in the urine of persons very sick with some fever, albumen and pale hyaline cylinders, while the kidneys are absolutely sound. The formation of all kinds of cylinders, whatever may be the mode of origin, is necessarily dependent on the excretion of albumen. The only exception are the so-called "testicle cylinders" (Plate 64).

Frequently we find adherent to the different cylinders epithelium, blood- and pus-corpuscles, granular detritus, salts, especially sodium urate, etc. In this manner many transition forms originate, and we are often doubtful to which group a cylinder should be ascribed.

The following principal forms may best be distinguished:

1. *Epithelial Cylinders* (Plate 27).—They simply represent tubes of epithelial cells which are glued together.

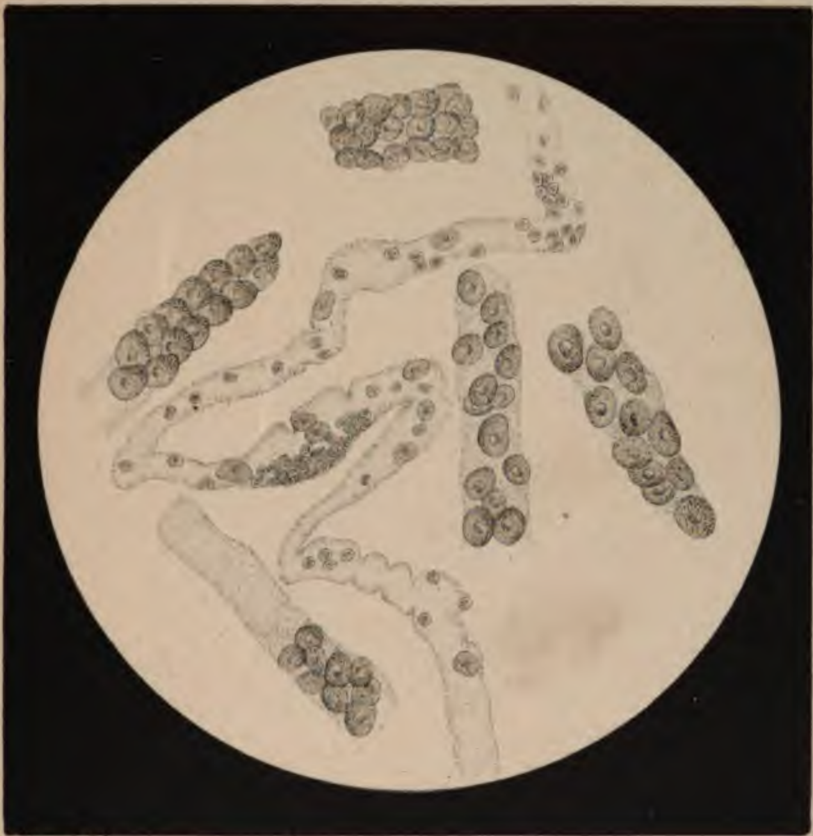
In acute inflammatory disturbances in the kidneys the epithelium may be detached in its natural connections and discharged in this shape with the urine.

The long curved form in this plate represents a so-called metamorphosed cylinder, a transition shape.

2. *Hyaline Cylinders* (Plate 28).—They are usually narrow and not equally wide in their whole length; generally they are curved or more or less bent. They are as transparent as glass, and some practice is required for their recognition under the microscope. Their transparency is sometimes disturbed by granular opacity and minutest fat-globules.

3. *Finely Granular Cylinders* (Plate 29).—Their outlines are sharp and their ends frequently rounded and finger-shaped. There are several modifications in their granulation; sometimes it disappears to such an extent as to resemble a hyaline cylinder; at others it is much coarser, and in some places we see real fat-globules.

PLATE 27



Mezger lith.

Epithelial cylinders and mixed cylinders.

Peyer's microscopy.

PLATE 28

Mezger lith.

Hyaline cylinders.

Peyer's microscopy.

PLATE 29

Mezger lith.

Finely granulated cylinders.

Peyer's microscopy.

PLATES 30, 31, 32.

BLOOD- AND FIBRIN-CYLINDERS.—WAXY CASTS.—SPURIOUS CYLINDERS.

4. *Blood- and Fibrin-Cylinders* (Plate 30) are caused by hæmaturia into the urinary tube of the kidneys, and consist of coagulated blood-plasma; at times these cylinders contain blood-corpuscles in such quantities as to appear dark and opaque.

5. *Waxy Casts* (Plate 31) have a peculiar waxy glaze and are always homogeneous; they are distinguished from the hyaline casts by their strong refractive power; they occur only in considerable width; they are found not only in amyloid degeneration of the kidneys, but also in chronic nephritis. As diagnostic signs they represent a grave disease of the kidneys.

6. *False Cylinders and Cylindroids* (Plate 32) can, under certain circumstances, be mistaken for real cylinders. Mucous shreds may most easily and frequently be mistaken for hyaline cylinders. As to the differential diagnosis I refer to the text to Plate 16.

Mucous cylinders may also be impregnated with sodium urate, and thus cause them to be mistaken for granular forms. The diagnosis will be established by the action of the former on addition of acetic acid.

The so-called uric-acid cylinders in new-born children consist of brown globes of ammonium urate and are of no importance for the practitioner.

PLATE 30

Mezger lith.

Blood and fibrin cylinders.

Peyer's microscopy.

PLATE 31

Mezger lith.

Waxy casts.

Peyer's microscopy.

PLATE 32

Mezger lith.

Spurious cylinders.
so called mucous cylinders.

Peyer's microscopy.

PLATES 33 AND 34.

EPITHELIUM.

EPITHELIUM

Is at times found in normal urine; abundant presence, however, is always a sign of disease. Formerly it was believed that the shape of the epithelium could be used for the diagnosis of the seat of disease—e. g., the imbricated aggregation of uniform epithelium (Plate 43) to be characteristic for pyelitis. This theory has been hedged in considerably since we know that there is no essential difference between the epithelium of the pelvis of the kidney and that of the ureters and the bladder, as all belong to Henle's transition epithelium.

We find in urine the epithelium of the urinary canaliculi mainly in consequence of disease of the kidneys, where they are frequently cast off in large masses in the form of epithelial cylinders.

For practical purposes we distinguish three forms of epithelium:

1. *Round Epithelia*, originating from renal canals and male urethra. They can not be distinguished from each other by their form. We find, however, usually the kidney epithelium as epithelium cylinder in albuminous urine (Plates 27, 37), and the epithelium of the urethra in the so-called gonorrhœal threads (Plates 52, 55). Thus we may naturally diagnose the place of their origin with facility. We can not distinguish from the epithelium of the urethra that of the prostate, and of Cowper's and Littré's glands.

2. *Pavement Epithelia* (Plate 33) occur in the bladder and vagina; they are hardly to be distinguished from each other; frequently they are cast off in shreds.

3. *Caudated Epithelia* originate generally from the pelvis of the kidney (Plate 42).

These relations are, however, complicated by the peculiarity that the transition epithelium from pelvis to urethra occurs in several layers, the middle one principally composed of smaller, more oval, caudated cells.

The caudated cells on Plate 34 originate from the neck of the male urethra, and are cast off after severe cauterization; they belong, therefore, probably to the middle layer.

PLATE 33

Mezger lith

Vesical and vaginal epithelium.

Peyer's microscopy.

PLATE 34

Mezger lith.

Epithelium of neck of bladder.

Peyer's microscopy.

PLATE 85.

BACTERIA OF URINE.

THE BACTERIA OF URINE.

Sooner or later after voidance of urine we observe in it bacteria, which, in a very short space of time, increase in an incredible manner.

They belong to the family of the fission fungi, Schizomycetes, and are either uni- or multicellular organisms, consisting of a peculiar albuminous body; they occur either singly or in colonies.

Urine rich in bacteria appears slightly turbid, has but a slight sediment, and is not entirely cleared by filtration.

It is not positively determined yet whether the bacteria reach the bladder through the urethra, or else pass by way of the blood into the uropoëtic system.

They have a fermentative effect, and cause the alkaline fermentation of urine in and outside the organism.

There are principally two forms of these fungi—the punctiform or micrococci, and the rod bacteria—both of which may occur singly or in colonies (zoöglœa). It is easy to mistake immovable or vibrating sphero-bacteria for earthy phosphates in molecular motion. Single rods are generally in rapidly oscillating condition.

Numbers of little rods in apposition are called *desmo-bacteria;* the joints can be recognized with a high power. These threads move slowly and sluggishly. Short rows are called *vibriones* (1); longer ones, which traverse the whole field, *leptothrix* (2).

Another one, also of fermentative influence and belonging to the Schizomycetes, is *Sarcina urinæ* (3), which may also be found in the stomach, stool, and expectoration. It is smaller than the *Sarcina ventriculi*, and resembles a bale roped crosswise. It is much rarer than the other forms of bacteria. (According to Klein, they are the result of four individual micrococci pressed closely together after division or in process of it.—TRANSLATOR.)

The urine frequently contains *yeast-fungi* (*Saccharomyces urinæ* (4); they belong to the blastomycetes, which have not the same medico-pathological importance as the bacilli, being unable to penetrate living tissue.

The yeast-fungi are cells, either single or connected, of various

PLATE 35

Mezger lith

Bacteria of the urine.

Peyer's microscopy.

size, but usually of that of leucocytes. Generally they are joined in rosary shape, but at times they are heaped together, or else several small cells are attached to larger ones, like buds. This fungus develops particularly well in diabetic urine.

It is important for the physician not to mistake them for white blood-globules; a careful attention to their smooth, bright exterior, to the absence of granules, the budding, which can always be seen on some of the cells, and to the reaction on acetic acid, will prevent error.

Of the mold-fungi we find *Penicillium glaucum* (5) in the urine. Its influence on the human body is also negative; although its spores are introduced with air, water, and food in large numbers; it rarely develops in the organism.

The filaments of this fungus are often in such great quantity in the urine that they form a regular network, the mycelium. We frequently find in it spores in a budding condition (6).

DISEASES OF THE KIDNEYS.

PLATE 36.

HYPERÆMIA OF THE KIDNEYS.

6

HYPERÆMIA OF THE KIDNEYS.

Passive hyperæmia is most frequent; the usual causes are heart affections, which, when no more compensated, influence the kidneys and their functions.

The average quantity of urine is much below the normal; albumen, however, in small proportion.

Microscopic View.—A few pale urine-cylinders; also a small number of often single blood-corpuscles.

Diagnosis.—Heart disease having been found, the following points are of value:

1. The small quantity of urine.
2. Its high specific gravity.
3. A small amount of albumen.

The anatomical appearance of the kidneys is usually called cyanotic induration; the kidneys are larger and tougher than natural. On bisection, we find both substances dark red, the medullary one being still the darker.

Microscopically, we find often the same result in *active hyperæmia*. At times the number of blood-corpuscles is increased, and epithelium present. This condition is always the result of toxic agents. The best known are cantharides and potassium nitrate. These noxious substances having been removed from the body, the normal relations are re-established.

The diagnosis of active hyperæmia is based on the inconveniently frequent desire to urinate, and from microscopic and chemical examination.

PLATE 36

Mezger lith.

Passive hyperemia of kidney.

Peyer's microscopy.

PLATES 37, 38, 39.

ACUTE PARENCHYMATOUS NEPHRITIS.

ACUTE PARENCHYMATOUS INFLAMMATION OF THE KIDNEYS.

(DESQUAMATIVE, ACUTE, HÆMORRHAGIC, CATARRHAL, AND CROUPOUS NEPHRITIS.)

1. *Causes.*—Those by which certain specific noxious substances are introduced into the kidneys through the blood, thereby creating irritation and inflammation—e. g., scarlatina, diphtheria. But local diseased condition of the skin, as erysipelas, carbuncle, phlegmon, may become the cause of acute inflammation of the kidneys.

2. *Colds.*—By a sudden cooling of the skin its capillaries are powerfully contracted; the blood is thereby forced into the interior of the body and the pressure in the inner organs increased.

3. Acute hæmorrhagic inflammation may, however, supervene in addition to existing chronic kidney diseases.

Course of the Disease.—The large majority result in recovery. Those caused by colds are usually the slowest and most apt to end in chronic disease.

The immediate danger consists in the retention of certain constituents of the urine, followed by acute uræmia. The quantity of urine falls to a few hundred cubic centimetres in twenty-four hours; death results quickly when complete suppression occurs. The insufficient excretion of water causes dropsy, which rarely is absent. In certain cases we find in the activity of the kidneys a guide as to the degree of danger. The possibility of uræmic complication is strong as long as the quantity of urine secreted is below normal.

Convalescence is always ushered in by an abnormal increase in urinary secretion.

The diagnosis must, first of all, be based on the etiology.

If, after one of the above-named causes, albuminuria appears, the urine contains blood, and hydrops follows, then the diagnosis is certain. The urine itself is mostly turbid, often brown or of the color of meat-juice. The specific gravity depends on the quantity of urine, and is, therefore, varying.

PLATE 37

Mezger lith.

Acute parenchymatous nephritis.

Peyer's microscopy.

PLATE 38

Mezger lith.

Acute parenchymatous nephritis,
after weeks existence.

Peyer's microscopy.

PLATE 39

Mezger lith.

Acute parenchymatous nephritis
before fatal termination.

Peyer's microscopy.

The appearance of cylinders is constant, but their number fluctuates. At times there are but few in urine holding a considerable quantity of blood. In very fresh cases the cylinders are narrow and hyaline, and frequently epithelium from the renal canaliculi adheres to them (Plate 37). Later, in addition to the hyaline cylinders, we find broad ones, with fine fat-globules, and also dark granulated ones (Plate 38).

In the last stages we see broad hyaline cylinders, epithelial and blood cylinders, and so-called waxy casts (Plate 39).

White and red blood-corpuscles are always present in various quantities in the initial stage; the red ones preponderate, later the white ones.

The drawings on Plates 37, 38, and 39 originate from the same patient; he was, after a severe cold, seized with acute nephritis, which ended fatally.

CHRONIC PARENCHYMATOUS INFLAMMATION OF THE KIDNEYS.

This disease in the majority of cases runs an insidious course. The first symptom, almost without exception, is the dropsy, which has its seat in the subcutaneous tissue. Alcohol does not influence its origin. The disease is rarely the result of the acute affection, and then especially when this latter is caused by cold. The dropsy attains at times a very high degree and yields but very slowly. But the recovery is incomplete when albumen remains in the urine, for then part of the tissue of the kidneys has perished. The patients then remain thin, retain a sallow complexion, and sooner or later succumb.

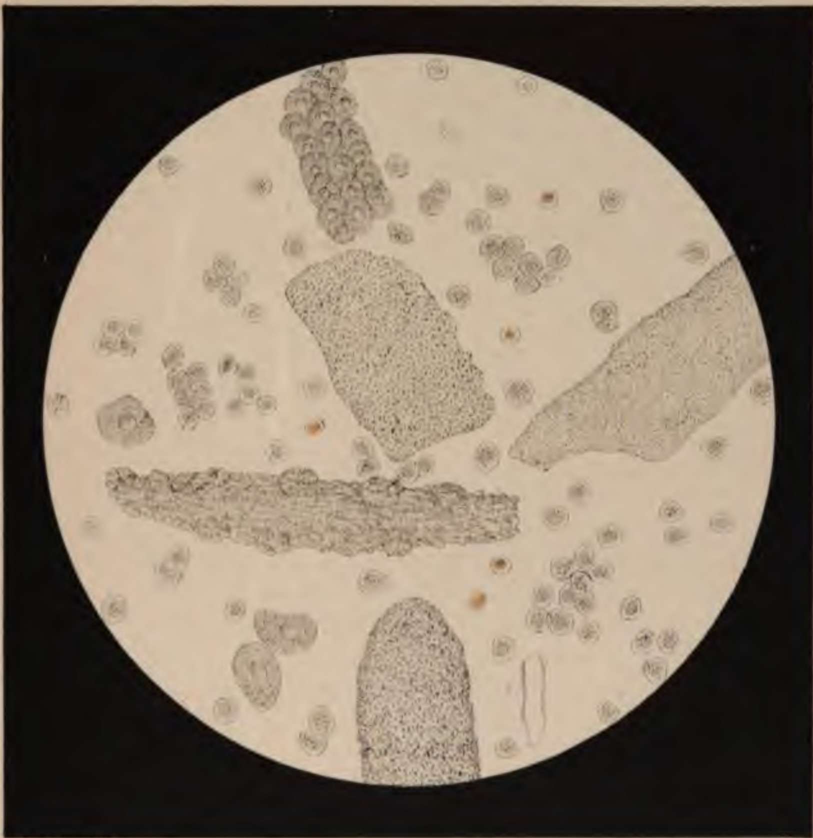
Diagnosis.—It is generally considered a sign of a fresh inflammation of the kidneys when the urine is strongly tinged with blood; but intercurrent hæmaturia may occur in chronic nephritis, even after complete cirrhosis has taken place. We may diagnose a chronic nephritis, when blood and epithelial cells are absent, when scanty urine with high specific gravity and abundant contents of albumen contains granular cylinders in large numbers with detritus. We have here also almost constantly dropsy. In simple *amyloid* degeneration the quantity of urine usually is normal, the urine pale and of abnormally low specific gravity; cylinders are in small numbers, while in chronic parenchymatous nephritis they are found in extraordinarily large quantity. In the beginning the majority have the mark of fresh origin. They are pale, hyaline, and slightly striped, or spotted with single dark molecules or fat-globules.

The longer the duration of the disease, the more abundant we find the granulated dark cylinders; the more the broad ones preponderate, the more frequent are the waxy casts.

White blood-corpuscles are always found in large numbers; red ones occur only exceptionally.

The scantier the urine, the richer it is in flocculent masses of agglomerated granular detritus. They are presumably relics of destroyed renal epithelium.

PLATE 40



Mezger lith.

Chronic parenchymatous nephritis.

Peyer's microscopy.

PLATE 41.

AMYLOID DEGENERATION OF THE KIDNEYS.

INTERSTITIAL INFLAMMATION OF THE KIDNEYS.

Genuine contraction or cirrhosis of the kidneys, the so-called third stage of Bright's disease, is the result of a primary increase of the intertubular connective tissue, and happens independently of the forms of inflammation heretofore described. It leads at once to waste of the glandular substance, which is not preceded by an inflammatory stage. In rare instances only an acute nephritis may give rise to the development of cirrhosis.

A genuine contraction may exist for a long while without exciting the attention of the patients.

The initial symptoms are: Palpitation of the heart, asthmatic attacks, severe headache in the form of hemicrania, sleeplessness, and visual disturbances; in later stages, vomiting and thirst.

The majority of the patients do not become dropsical, but die from uræmia, apoplexy, or from inflammatory effusions into the serous sacs, or finally from inflammatory infiltration of the lung-tissue.

A diagnosis is only possible by careful examination of the urine and the condition of the heart.

The urine is at times normal. Albuminuria is not a constant occurrence; it seems to depend in many cases on the position in the bed, but it is one of the characteristic symptoms whenever it occurs.

The quantity of urine is increased in a remarkable manner. Frequently it happens that such patients, on account of their thirst and frequent desire to urinate, believe themselves diabetic. But this condition is neither prominent at the outset nor does it hold out to the end.

In order to be examined with the microscope, the urine, which is yellowish green or pale yellow, has to be decanted and the remainder collected in funnel-shaped glasses.

The cylinders are scarce, of the narrow kind, and entirely hyaline.

Amyloid degeneration of the kidneys is almost always the result of existing or past anomalies of the constitution, as scrofula, chronic tubercle, constitutional or inherited syphilis. Other organs,

PLATE 41

Mezger lith.

Amyloid degeneration of kidney.

Peyer's microscopy.

in addition to the kidneys, are almost constantly a seat of amyloid degeneration; that of the kidneys is therefore always part of a general disease.

The development of the disease is insidious, devoid of symptoms; usually it is recognized only after the appearance of ascites, which is very obstinate. The fatal issue is brought about by gradual exhaustion. The urine generally is abundant; its specific gravity changes with the quantity excreted.

Albumen is always present, but in varied proportion. The urine is clear, and usually forms no sediment; cylinders are, therefore, rarely seen, most frequently when the urine is of high specific gravity and with abundant contents of albumen. The cylinders when scarce are almost constantly of a narrow sort and hyaline. When they occur in larger quantities they belong to the broad variety, but those with waxy hue and yellowish color, as well as the dark, granular ones, are found in great numbers also.

The diagnosis is entirely etiological. But the chronic parenchymatous inflammation occurs under the same circumstances. In both cases the diurnal quantity of urine may be small, the specific gravity high, and the amount of albumen considerable.

Differential Diagnosis.—In amyloid degeneration the urine is scanty, rarely forms sediments, contains a few hyaline cylinders, almost never blood-corpuscles. The quantity and quality of the urine vary greatly.

In chronic nephritis the urine is scanty, always turbid, of very dirty color, and forms abundant sediments; frequently it contains blood-corpuscles, single or in bodies. Quantity and quality of the urine vary at long intervals.

Swelling of the spleen is diagnostically important in amyloid degeneration.

When this latter is combined with polyuria, we may find great difficulty in distinguishing it from cirrhosis. In these cases we have to rely on the etiology and the absence of hypertrophy of the heart.

PLATE 42.

RENAL HÆMORRHAGE.

HÆMORRHAGE OF THE KIDNEYS.

We usually first suspect the presence of blood in urine from the coloring, the intensity of which varies according to the quantity of blood admixed. It is at times very difficult to ascertain the exact origin of this blood.

In diagnosing renal hæmorrhage we must, first of all, consider that it is of a parenchymatous character—i. e., it rises from capillary vessels, and is therefore not copious. Coagula recognizable with the naked eye do not originate, therefore, in the kidney. For the same reason we find in renal hæmorrhage the microcytes. (See text to Plate 26.)

The frequent admixture of renal epithelium in hæmorrhage of the kidney is also of importance (Plate 43).

The reaction of the urine is only of negative value for diagnosis; it does not originate from the bladder if it is acid, and if otherwise the symptoms of a vesical catarrh can be excluded.

Continued renal hæmorrhage occurs most frequently in acute diffuse nephritis. In this case the blood and fibrin-cylinders and the abundant albumen are characteristic.

We observe further renal hæmorrhage in acute hæmorrhagic exanthemata and infectious diseases, in diseases of the renal vessels (embolus, atheroma), in neoplasms and trauma; further, in renal stones.

PLATE 42

Mezger lith.

Hemorrhage of kidney.

Peyer's microscopy.

PLATE 43.

PYELITIS.

PYELITIS

Is often seen as a part phase of several general diseases, as puerperal fever, typhus, diphtheria, scurvy, morbus maculosus Werlhofii; further, of acute and chronic forms of nephritis.

Like the inflammations of the parenchyma and the other urinary channels, it is spontaneously developed by large doses of cantharides, etc.

Of special importance are the cases occurring through presence of renal calculi; also those originating from ammoniacal decomposition of the urine in the bladder.

Pyelitis is frequently developed in pregnancy and in the lying-in state in consequence of vesical catarrh and by transfer of inflammation from neighboring parts. Colds are considered a frequent cause.

Diagnosis.—The assertion that the urine of pyelitis is always acid, and that of vesical catarrh always alkaline, is absolutely incorrect; we often find inverse conditions. Neither can we rely on the epithelium.

It appears frequently, it is true, in pyelitis in imbricated aggregation, and is then of great value for the diagnosis, but just as frequently it is absent.

The diagnosis of pyelitis is mainly based on the presence of blood and pus in urine, with uneasiness in the region of the kidneys, while the bladder causes no disturbance.

The diagnosis is very difficult when vesical catarrh is combined with pyelitis; here we have to rely on the chronology of the symptoms after a very careful anamnesis.

Grave forms of pyelitis not infrequently escape observation during life when they occur in conjunction with other severe diseases.

The appearance of rare renal cylinders in a sediment containing blood and pus does not point to vesical catarrh, but to pyelitis, for the straight renal canals are frequently implicated.

PLATE 43

Mezger lith.

Acute pyelitis.

Peyer's microscopy.

PLATES 44 AND 45.

ACUTE VESICAL CATARRH.

7

ACUTE VESICAL CATARRH

May terminate in rare instances in one to two days; usually, however, its duration extends over one to two weeks. There is much difference also in the intensity of the affection. The sole symptoms in milder cases are a more frequent desire to urinate, and a slight burning accompanying it. The general health is not affected. Microscopic examination reveals a slight increase of white blood-corpuscles in the urine; the mucus is also augmented; the reaction is absolutely acid.

Usually these cases occur in consequence of slight colds, or with the male sex in consequence of drinking new beer or wine. They terminate in a few days without any medication.

The frequency of desire of micturition increases as the cases are more severe. The patients can scarcely relinquish the vessel for a moment; each time a few drops of turbid urine are passed with a severe sense of burning; fever commences, and the digestion is disturbed.

These cases are usually the result of severe colds; also of propagation of the inflammation of neighboring organs, as in gonorrhœa; also by unskillful catheterization, whereby bacteria are carried into the bladder. The internal use of certain remedies—e. g., cantharides—may also cause such inflammation.

In a little while a sediment is formed in such urine, more or less abundant, and, according to the admixture of blood, from grayish white to reddish brown.

The reaction may be either acid or alkaline; this depends mainly on the original cause—i. e., if infection or otherwise. It is acid when it does not contain bacteria. The microscopic picture coincides with the reaction.

Plate 44 is the picture of an acute vesical catarrh, with acid reaction; it originated suddenly in a woman after a severe cold. We see very few bacteria, and even these found, probably, access to the urine after it was voided. There are visible, however, many red blood-corpuscles, less white ones, and a moderate quantity of epithelium.

PLATE 44

Mezger lith.

Acute vesical catarrh,
(acid reaction of urine).

Peyer's microscopy.

PLATE 45

Mezger lith.

Acute vesical catarrh,
(alkaline reaction).

Peyer's microscopy.

Plate 45 represents an acute vesical catarrh, with alkaline reaction; the urine originated from a lying-in woman whose bladder had been paralyzed by forceps delivery, and, in consequence thereof, had to be catheterized.

The catarrh commenced after the first application of the instrument, and we have, without doubt, to deal with infection by the catheter. We see large numbers of bacteria, ammonium urate, and coffin-shaped crystals; the epithelium appears somewhat swollen; the white blood-corpuscles prevail. The presence of bacteria does not, however, at all times call forth an alkaline reaction, for we find cases of vesical catarrh when the bladder is a real hot-bed of bacteria, and still the urine is acid.

PLATES 46 AND 47.

CHRONIC VESICAL CATARRH.

CHRONIC VESICAL CATARRH

May present various pictures, according to the degree of its intensity and the cause and mode of origin. The symptoms present in acute cystitis are almost entirely absent, and the patients have but few complaints. Usually these are confined to an increased desire to micturate, accompanied by an uncomfortable feeling. Sometimes these symptoms are so slight that a certain cloudy appearance of the urine first attracts the attention of the patients. A mistake may principally be made in differential diagnosis by its resemblance to chronic disease of the kidneys or the urinary channels. The first can be excluded by the discovery of abundance of albumen and cylinders; the latter by causing the urine to be voided in two portions, which are to be examined separately.

Several forms of vesical catarrh are represented in Plates 46 to 49.

The lightest form is that of catarrh of the neck of the bladder (Plate 51), found at times as complication of a gleet which had disappeared to a few traces. The patient feels no inconvenience from the bladder, except that he voids his urine more frequently. This desire to urinate becomes more urgent as soon as he drinks beer or wine, or takes cold; then he is awakened at night by it three or four times. The urine is acid, and contains a number of small flakes which resemble gonorrhœal threads. Their microscopic appearance, however, is different, for vesical epithelium is imbedded in the mucus in place of the small epithelium of the urethra. These cases of vesical catarrh, existing unknown through a long range of years, are of practical importance, because through their long-continued existence the volume of the bladder is more or less diminished, and thereby the capacity to retain urine for any length of time.

Plate 46 is the picture of a chronic vesical catarrh caused by frequent catheterization for hypertrophy of the prostate in an elderly gentleman. The urine was constantly acid, owing to disinfecting injections. We find in the sediment a moderate number of pus-corpuscles, a few single blood-corpuscles, and a quantity of fat-

PLATE 46

Merger lith.

Chronic vesical catarrh (acid reaction), fat globules from the catheter and blood from injury by same.

Peyer's microscopy.

PLATE 47

Mezger lith.

Chronic vesical catarrh.

Peyer's microscopy.

globules of various sizes, resulting from the oil which has, by the repeated daily use of the catheter, been introduced into the bladder.

We have remarked above that the bacteria are mainly the cause of alkaline reaction in urine. On Plate 47 we see such a mass of bacteria that they are partly concealing the pus-corpuscles, and still the urine is at times acid or neutral, and only temporarily alkaline.

PLATE 48.

CHRONIC VESICAL CATARRH AND LIPURIA.

CHRONIC VESICAL CATARRH (*Continued*).

The pus-corpuscles swell and are partly dissolved when the urine is alkaline. On Plate 48 we see this condition nearly completed; they then form a tough, thready mass, in which we can still recognize plainly swollen vesical epithelium and crystals with pus-corpuscles in a state of solution.

Lipuria (Plate 48).

Fat-globules can frequently be demonstrated in the urine by the microscope, but they do not always originate in the urine. At least it is always well to examine carefully if the urinal did not contain oil; or, when this is not the case, if the oil has not been introduced into the bladder from without, as by catheterization, even if this has taken place some days before the discovery of the globules.

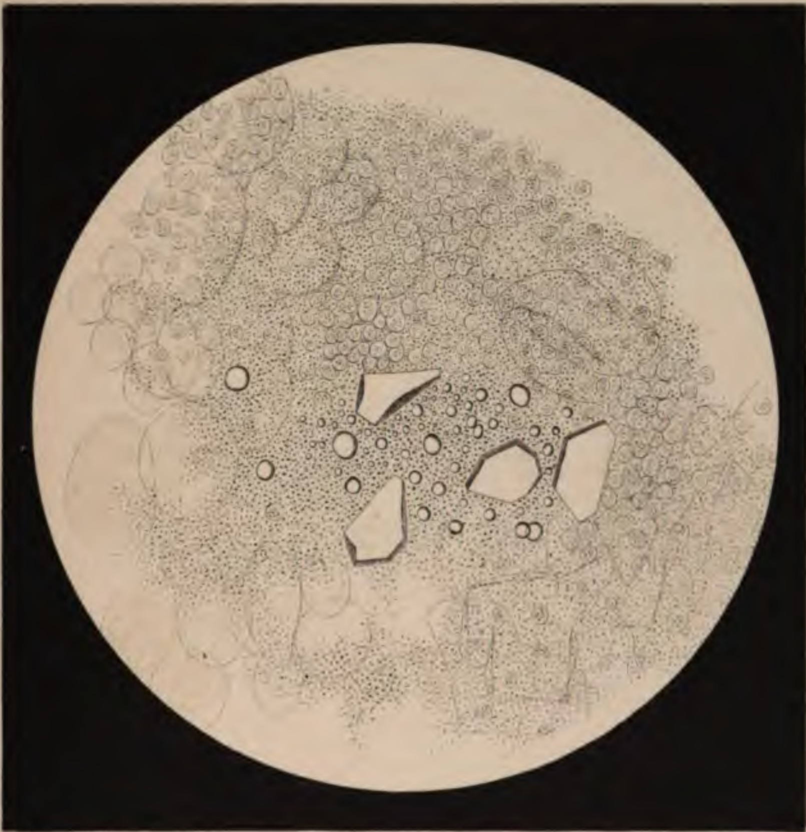
Cases where, the kidneys being healthy, fat is excreted from the blood into the urine are not frequent, but they exist. Excessive contents of fat in the blood, as in abundant ingestion of fat or oils, are necessary, or else we find it in the so-called chyluria, which, however, is rare.

Fat-globules have been repeatedly discovered in urine in chronic osseous diseases and in diabetes; also in grave cachexias brought about by other causes. Naturally we will find them in all diseases connected with fatty degeneration of renal epithelium, as in nephritis and after poisoning.

The microscope alone is necessary for the discovery of fat in urine; the fat-globules are easily recognized as small, strongly refracting, shining spherules, which are readily soluble in ether.

The specimen of Plate 48 is taken from a very cachectic individual with severe vesical catarrh and evening fever; he has never been catheterized.

PLATE 48



Mezger lith.

Chronic vesical catarrh (alkaline reaction).
Fat globules in urine.

Peyer's microscopy.

PLATE 49.

CHRONIC VESICAL CATARRH, WITH ACID REACTION.—ECTASIES OF THE BLADDER, WITH ALKALINE CONTENTS.

CHRONIC VESICAL CATARRH (*Continued*).

Speaking of the alkaline fermentation of urine, we have already mentioned that in the same urine several layers could show different reaction, and also that this could already take place in the bladder.

This latter observation can principally be made when, in consequence of hypertrophy of the prostate or stricture of the urethra, in conjunction with long-continued catarrh, dilatation and ectasia of the bladder have been formed.

The sediment of this catarrhal urine remains in these pockets often for a considerable time, and undergoes further fermentation, in which the urine, which freshly arrives from the kidneys, does not participate at once. We find, then, the extraordinary appearance that, with an acid urine, shreds are voided which, under the microscope, resemble the picture of Plate 49—blood, pus, epithelium, coffin-shaped crystals, imbedded and held in a mucous mass, or else the patients void spontaneously an acid, tolerably clear urine, while on introduction of the catheter we remove a quantity of more turbid urine with neutral reaction, and at last a remainder of a mucopurulent mass with alkaline reaction. On being allowed to remain *in situ* for some time, the catheter brings forth again acid urine which is freshly secreted by the kidneys.

PLATE 49

Mezger lith.

Chronic catarrh (acid reaction of urine).
Ectasy of bladder with alkaline contents.

Peyer's microscopy.

PLATE 50.

VESICAL HÆMORRHAGE.

VESICAL HÆMORRHAGES

Are found only in ulcerations, cancer, concretions, foreign bodies, and varices of the bladder, or else in case of acute inflammation of the same, or with entozoa (*Distoma hæmatobium*).

Very voluminous coagula are at times produced by vesical hæmorrhage—so much so that they have to be broken up before they are able to pass, and frequently cause strangury.

Such coagula may lead to the formation of vesical calculi. The differential diagnosis between vesical and renal hæmorrhage is established by the discovery of vesical catarrh and its cause; for the causes of vesical *hæmorrhage*, such as cancer, foreign bodies, etc., cause also vesical *catarrh*. The diagnosis is confirmed if we can exclude the simultaneous existence of renal disease.

Hæmorrhage from the urethra is easily recognized by the fact that the blood flows in a continuous stream without first being mixed with urine.

We find it in acute and chronic gonorrhœa always mixed with pus; further, in forced coitus, in unskilled catheterization, in phlebectasia in the prostatic portion.

Hæmorrhages from the *neck* of the bladder occur in gonorrhœa in the latter stage of the disease; also in fissures which are distinguished by great painfulness. In these cases the blood usually appears only toward the end of the micturition—i. e., when the sphincter vesicæ commences contracting.

PLATE 50

Mezger lith.

Hemorrhage of bladder.

Peyer's microscopy.

PLATES 51, 52, 53, 54.

CHRONIC URETHRITIS.

CHRONIC URETHRITIS

Causes in many cases so little inconvenience that the persons affected have no idea of its existence. The principal symptoms are a more frequent desire to micturate, connected with slight incommodity or burning, and, occasionally, sealing up of the urethra in the morning.

The diagnosis is, therefore, frequently made accidentally when the urine is examined for other purposes.

We have again here to refer to our caution to examine the urine in two parts.

We find in the first morning urine of such a patient, on examining it in a glass bottle with transmitted light, little threads swimming about, in which numerous pus-corpuscles are imbedded, sometimes mixed with epithelium; they are the so-called gonorrhœal, or, better, urethral threads.

From an ætiological and prognostic point of view, we distinguish three forms of chronic urethritis, but neither microscopically nor macroscopically do they show much difference.

The first and most frequent form is the *old chronic* gonorrhœa; this is represented on Plates 51, 52, 53, and 54.

On Plate 51 we see a long, thin, and a tolerably broad gonorrhœal thread, which both consist entirely of mucus and pus-cells.

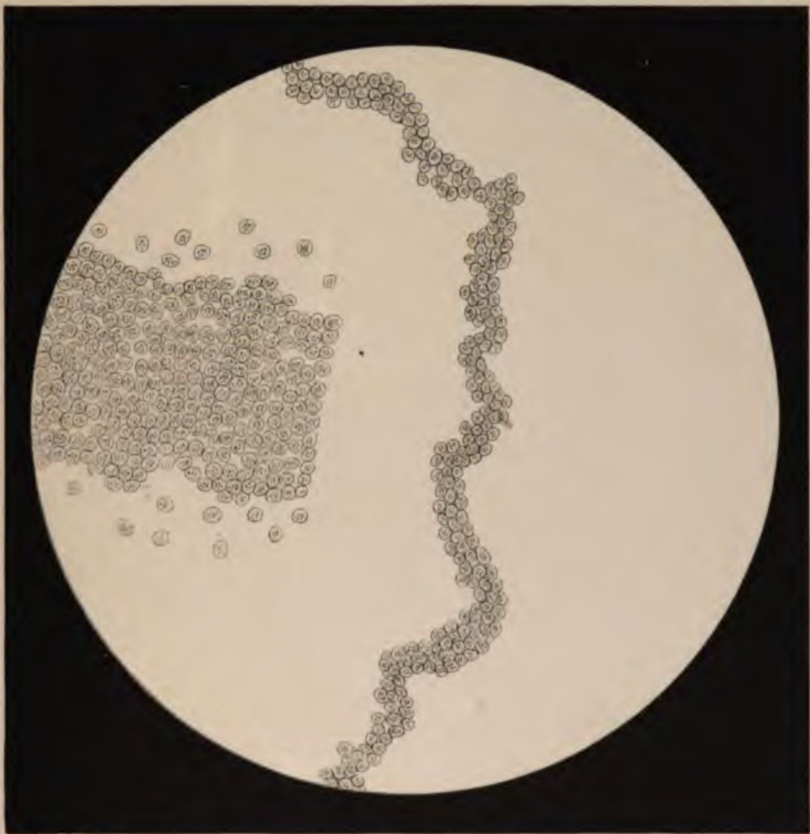
These threads are elastic and transparent when the mucous part preponderates; when the cellular elements occur in excess, the threads are opaque and fragile.

On Plate 52 we find the pus-cells mixed with round or oval epithelium of various sizes.

Plate 53 represents a gonorrhœal thread with spermatozoids imbedded. As pertinent to this picture we must remark that spermatorrhœa is rarely a consequence of gonorrhœa, although the two are quite frequently found co-existing.

Usually the patient, before acquiring the gonorrhœa, had been a slave to masturbation for some time, and had already suffered from spermatorrhœa, or, at least, debility of the sexual organs. Thus I

PLATE 51



Mezger lith.

Gonorrhoeal threads (without epithelium).

Peyer's microscopy.

PLATE 52

Mezger lith.

Gonorrhoeal threads (with epithelium).

Peyer's microscopy.

PLATE 53

Mezger lith.

Gonorrhoeal threads (with sperma).

Peyer's microscopy

PLATE 54

Mezger lith.

Chronic gonorrhoea
with implication of neck of bladder.

Peyer's microscopy.

ascertained, by frequent examination with the microscope during a whole year, entire recovery in a case of spermatorrhœa resulting from onanism. This patient now acquired a slight gonorrhœa, and, in consequence, the spermatorrhœa reappeared.

We may safely establish the doctrine that gonorrhœa alone can not cause spermatorrhœa unless by previous abuse the sexual system had been weakened.

Plate 54 is the microscopic picture of the so-called *goutte militaire*, a small, grayish-white plug which, on rising in the morning, is found to close the mouth of the urethra.

The mucus is but slightly represented, while the cellular elements, especially epithelium, are in great preponderance. The form of the epithelium leads us to judge that the seat of the disease is far back, partly implicating even the neck of the bladder.

The importance of this gleet is not to be despised.

First, we do not know how soon this chronic disease may by some noxious agency become acute.

Secondly, it may lead to chronic inflammation and hypertrophy of the prostate.

Thirdly, we know that the formation of strictures results from this condition—reasons enough to give this affection the attention which it merits.

PLATE 55.

CHRONIC URETHRITIS FROM MASTURBATION.

CHRONIC URETHRITIS FROM MASTURBATION.

A form of chronic urethritis, brought about by *long-continued masturbation*, has another significance. This form is not even rare, although its existence even has been doubted by many.

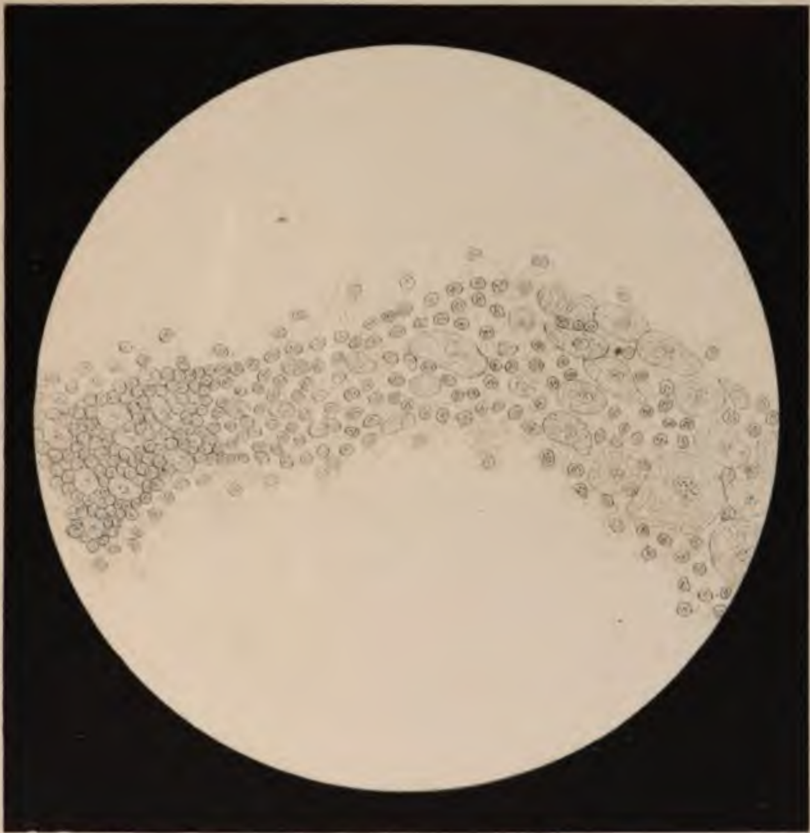
We find it in young men who never have had a coitus, and actually would not be able to have it on account of total impotence.

The preparation from which Plate 55 is copied comes from a young man who frequently attempted coitus, but unsuccessfully, the erections being too incomplete. It is entirely similar to the one represented on Plate 52, which is caused by gonorrhœa.

This form of chronic urethritis gains importance by the fact that gonorrhœal poison adheres easier to the flabby tissues, thus inducing greater susceptibility to gonorrhœal infection. A gonorrhœa once established becomes more easily chronic.

This form of chronic urethritis never leads to strictures, as we find it to be the case at times in the specific form, but it may be influential in the formation of prostatic hypertrophy in later years.

PLATE 55



Mezger lith.

Chronic urethritis
in consequence of long continued masturbation.

Peyer's microscopy.

PLATE 56.

CHRONIC URETHRITIS IN CONSEQUENCE OF MECHANICAL OR CHEMICAL INJURIES TO THE URETHRA.

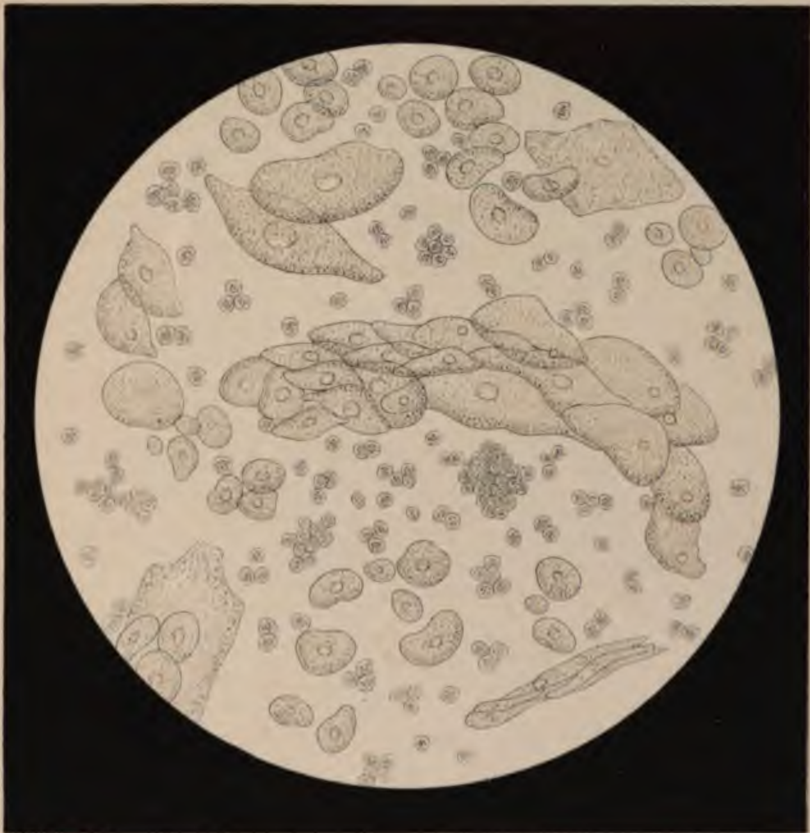
CHRONIC URETHRITIS IN CONSEQUENCE OF MECHANICAL OR CHEMICAL INJURIES TO THE URETHRA.

A third form of chronic urethritis results from mechanical or chemical injuries to the urethra. One of the most common causes is the frequent unskillful introduction of the catheter, or its uncleanness; further, the application of cauterizing remedies, such as those which have to be used in spermatorrhœa. It is sufficiently well known that the catheter in unskilled hands may be the cause of grave lesions, and we will therefore revert here only to the cauterization of the urethra. Its results, being always of an intense nature, may be absolutely pernicious in the hands of a careless or unconscientious physician.

We will briefly relate here such a case, Plate 56 representing a picture of the discharge. Mr. M., twenty-two years of age, had practiced during earlier years self-abuse to a moderate degree without feeling the slightest bad results. Through reading works on self-abuse he became a hypochondriac, and fell into the hands of a so-called specialist, who, without previous examination of any kind, cauterized the prostatic part about seventy times during eight months. The consequences were double orchitis with permanent induration of the epididymis and a discharge resembling gonorrhœa lasting for years, increased desire to micturate, pains in the small of the back, congestion of the head, etc.

Similar cases, although less pronounced, are frequent, and we must lay great stress on the danger of these local applications when they are not wielded by well-informed and absolutely conscientious physicians.

PLATE 56



Mezger lith

Chronic urethritis
consequent upon excessive use of Lallemand injections.

Peyer's microscopy.

PLATES 57 AND 58.

SECRETIONS OF THE ACCESSORY GENITAL GLANDS.

SECRETION OF THE ACCESSORY GENITAL GLANDS.

Before entering upon the discussion of real spermatorrhœa, we have to speak of an affection which, not only by laymen, but often by physicians, is taken for seminal flow—we mean the increased passage of the secretion of the genital glands on erections or other sexual excitement. Formerly it was taken for prostatic fluid; of late, however, it has been pretty positively established that this clear, viscous, thready secretion with alkaline reaction originates from Cowper's glands. We usually find this hypersecretion only in cases of chronic excessive excitement of the genital system, in consequence of masturbation or other abuse, which explains its being taken for spermatorrhœa. In some cases the quantity of this secretion passed during a single erection amounts to a small teaspoonful. Generally we find in it no solid substances, with the exception of beautiful coffin-shaped crystals; exceptionally there are spermatozoa in considerable numbers, and thereby the examining physician may be misled.) Plate 57 represents this occurrence. At later examinations, however, of such secretion in the same patient, no more spermatozoids were discovered, and the patient told me afterward that he had caught this secretion one morning early during an erection, after having had a pollution during the night. Thus the admixture of semen is shown to have been accidental.

It is necessary to bear this in mind, as otherwise a diagnosis of spermatorrhœa may be made when none exists.

This mucus passes off, not only during an erection or other sexual excitement, but it escapes frequently, without the knowledge of the patient, with the urine.

It gathers occasionally in considerable quantity at the bottom of the urinal as a clear, gelatinous mass, imperceptible to the naked eye on account of its transparency, and is accidentally picked up sometimes when searching with the pipette for other things.

Under the microscope we frequently find in this mass, excepting a few mucous cells and epithelium, nothing but at times a large number of beautiful little coffin-shaped crystals, and pointed

PLATE 57

Mezger lith.

Secretion of genital glands during erection.

Peyer's microscopy.

PLATE 58

Mezger lith.

Alkaline mucus in acid urine.

Peyer's microscopy.

crystals of calcium phosphate; this appearance naturally depends on the alkaline condition of the urine, which can be verified by testing with litmus-paper. The urine itself, however, is acid, and thus we have a strongly alkaline mucous sediment in a completely acid urine. I have especially found this peculiar condition in chronic excitement of the sexual system, as it frequently happens in consequence of too frequent coitus in young husbands or else in masturbators. Several times I have been able to diagnose positively from this microscopic examination masturbation in young men, who at first positively denied it.

SPERMATORRHŒA.

PLATES 59-63.

SPERMATORRHŒA—LAST DROP AFTER URINATING.

SPERMATORRHŒA

Is an abnormal loss of semen, occurring mostly on certain occasions, and not, as was formerly assumed, as a steady urethral flow similar to gonorrhœa. These occasions are the ordinary micturition, or passing water at stool, especially when hard fæces traverse the rectum; in advanced cases the semen may be evacuated by a mere pressure on the abdomen, or on lifting heavy weights, or in consequence of lewd thoughts. We count with spermatorrhœa also nocturnal emissions when they occur very frequently or in a morbid manner—i. e., without sensation or erection.

First of all, we must insist that spermatorrhœa in itself is not a disease, as little as fluor albus in the female sex, but that it is only a symptom of various pathologico-anatomical conditions, affecting either locally the seminal vesicles, their ducts, their muscles and surrounding mucous membrane, or else resulting from general disturbances of the body, especially in the nervous system.

The several nervous disorders which accompany spermatorrhœa are mostly not its consequences, but co-ordinate symptoms of a pathologico-anatomical condition, the original cause of this loss of semen.

Masturbation furnishes the principal contingent of these cases, closely followed in frequency by other sexual excesses and abuses.

Even excessive natural coitus may lead to spermatorrhœa, the sexual powers varying greatly in the several individuals.

A peril almost equal to that of masturbation is incurred by "reserved coitus." I would be almost inclined to consider this frequent cause of spermatorrhœa as equal in its deleterious consequences to onanism; but its consequences are more apparent in mature age, while masturbation is a cause of spermatorrhœa in youth.

Other causes, but less frequent, are a general debility of the blood and nervous system, the so-called neurasthenia, be it congenital, inherited, or else acquired in consequence of severe exhausting diseases or excessive bodily or mental excitement or strain.

The *frequency* of spermatorrhœa and its influence on the body have been judged very differently. After the exaggerated descrip-

PLATE 59

Mezger lith.

Spermatorrhoea.
Last drop after urinating.

Peyer's microscopy.

tions of Lallemand had drawn the general attention for some time to this chapter of pathology, a reaction took place, when this disease almost passed into oblivion. Its existence was considered a rare occurrence, and many authors and physicians of the present time still adhere to this view.

My experience, gained by very numerous investigations of this subject, leads me to the positive assertion that spermatorrhœa is not only not rare, but a frequent disease.

Still I agree with Zeissl when he says that *gonorrhœal* spermatorrhœa—i. e., that caused by gonorrhœa—rarely occurs. (See Chronic Urethritis, Plate 53.)

The main reason for the difference of opinion on this subject seems to be the tedious examination necessary, and the difficulty of always obtaining the necessary samples of urine; for the microscopic examination of the urine must be made frequently, and has to be extended at least over two weeks if positive results have not been obtained sooner.

I request the patient, whenever there is a suspicion of spermatorrhœa during his examination, to furnish me the following samples of urine:

1. Several vials of ordinary day urine.
2. Several vials of morning urine from different days.
3. He should collect several times during the stool the last few spoonfuls of urine voided at that time.

In the following six plates I present the several microscopic appearances of spermatorrhœa.

Plate 59 represents the microscopic appearance of an alkaline, viscous fluid, which, at the close of defecation, escapes from the urethra of a strongly built man, forty-two years old, a painter. This is accompanied by an army of nervous symptoms; his wedded life is childless. The fluid contains spermatozoa, lymphatic bodies, and crystals of sperma. During the day the pollutions occur on crouching or spreading the legs, which position is frequently assumed by painters. These effusions occur with considerable sensual feeling, but without erection or previous lewd thoughts, and are followed by general and considerable depression. We have here, therefore, a double form of spermatorrhœa, which, however, is not absolutely rare.

PLATES 60 AND 61.

SPERMATORRHŒA IN MORNING URINE.—SPERMATORRHŒA IN THE URINE OF AN EPILEPTIC.

SPERMATORRHŒA.

Spermatorrhœa can easiest be demonstrated in the first urine of the morning; we find in it seminal threads and lymphatic cells as form-elements of the spermal fluid; the crystals of sperma are dissolved in urine, and can not, therefore, be found when the semen has been for some time in contact with urine.

Plate 60 originates from a strongly built agriculturist, twenty-five years of age. He desires to marry, and has consulted me on account of general ailing, disturbance of the stomach, and total impotence. Patient practiced self-abuse to a considerable extent during his youth, and has since frequently tried coitus, but unsuccessfully, because the ejaculation took place before the erection was complete. The first five samples of urine contain no semen; the sixth one is absolutely opaque. On standing, a sediment is formed representing the picture of pollution, with the exception of the spermatic crystals. A pollution had not preceded. We find from time to time such enormous loss of semen without sensation of the patient.

Plate 61 represents the secretion of an epileptic suffering from spermatorrhœa. Patient, a peasant fifty-two years of age, from the "Black Forest," great drinker and smoker, has suffered for a number of years from epileptic convulsions, which continually increase in frequency.

On examining the urine after such an attack, I found a considerable flocculent, grayish-white sediment, which, on shaking, was spread through the urine like gonorrhœal threads. Under the microscope the shreds present the picture of Plate 61; they are large agglomerations of seminal threads with lymph-cells, held together by a glutinous substance.

This loss of semen is not regularly found after the epileptic attacks, but also appears during the stools and in the morning urine.

I wish here to remark that I have found abundant spermatorrhœa in five cases of epilepsy.

PLATE 60

Mezger lith.

Spermatorrhoea in morning urine.

Peyers microscopy.

PLATE 61

Mezger lith.

Spermatorrhoea in urine of an epileptic.

Peyer's microscopy.

PLATE 62.

SPERMATORRHŒA IN SPINAL IRRITATION.

9

SPERMATORRHŒA IN SPINAL IRRITATION.

Spermatorrhœa is not a rare accompaniment of spinal irritation, and is to the latter in the same relation as uterine diseases in the female to the pains in the back and loins. We have to search for sexual anomalies whenever we diagnose in a man the symptoms of chronic spinal irritation. The case represented on Plate 62 is that of a polytechnic student suffering from spinal irritation. This latter is so intense that the patient can not bear the slightest pressure on the spinal column; he wears no overcoat in the coldest winter, because he can not endure the weight of that garment. Other symptoms are abnormal sensations in the legs, very frequent desire to urinate, fullness of the head, loss of memory, and psychical irritability. Patient formerly masturbated excessively. Later he caught gonorrhœa, which became chronic, and, on examination of the urine, we find daily semen in the urine, once in the form of Plate 62—shreds, in which lymph-cells and seminal threads are agglomerated in large masses by a glutinous substance; at other times in the form of Plate 53—gonorrhœal threads impregnated with spermatozoids.

PLATE 62

Mezger lith.

Spermatorrhoea in spinal irritation.

Peyer's microscopy.

PLATE 63.

SPERMATORRHŒA—LAST DROP FROM THE URETHRA DURING DIFFICULT STOOL.

SPERMATORRHŒA (*Continued*).

The form of spermatorrhœa which is represented on Plate 63, the last drops of urine passed during the stool having a milky color and glutinous consistence, is at times diagnosed by the patient himself; he usually asserts that he observed this peculiar liquid accidentally. On taking this drop between the fingers, it gives a fatty, soapy sensation; otherwise it resembles the semen. These drops, which, under the microscope, represent pure seminal fluid, pass occasionally, but rarely, at the *beginning* of the stool, when the abdominal pressure commences; but generally they appear at the *close*, when the final contractions are made by the sphincter ani, and thereby the seminal vesicles compressed. In rare instances this seminal fluid passes some time after the completion of the stool, and when the patient is already dressing. This occurs, then, with more or less disagreeable, even painful sensation; in one case I observed even a chill.

PLATE 63

Mezger lith.

Last drops from urethra during difficult stool.
(Milky opacity, alkaline reaction.)

Peyer's microscopy.

PLATE 65.

SPERMATIC FLUID IN RELATIVE ASPERMATISMUS.

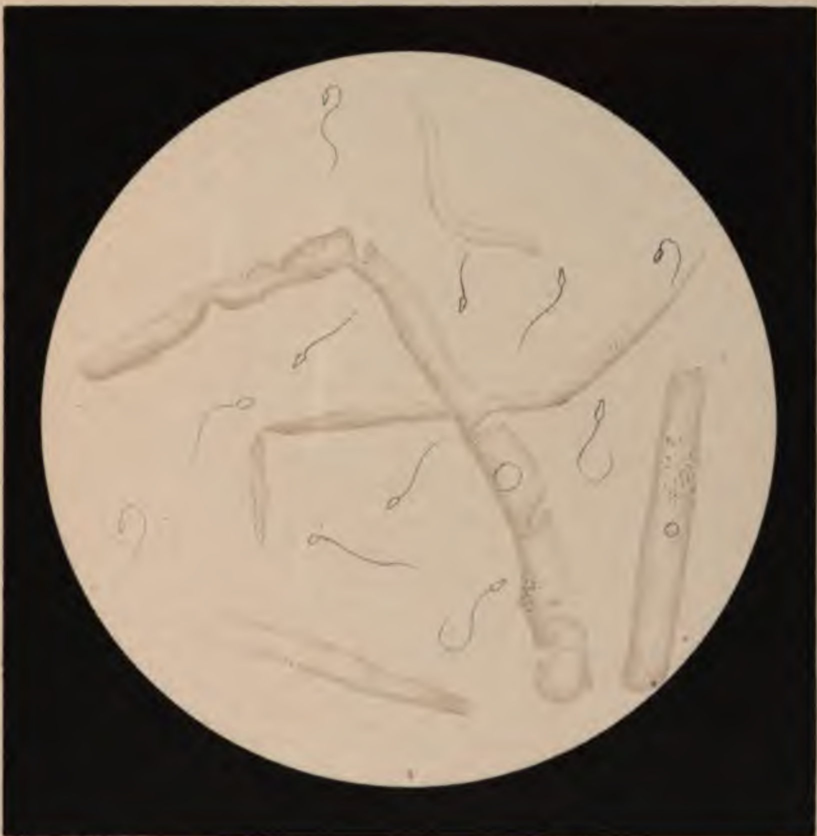
HYALINE CYLINDERS IN SPERMATORRHŒA.

This has been demonstrated lately. In a large number of cases of spermatorrhœa which I have examined I have observed this occurrence four times. Plate 64 represents a specimen from the case of an unmarried young merchant, who consulted me on account of chronic diarrhœa and loss of flesh. Chemically, I found nothing abnormal in the urine, but with the microscope I discovered a moderate spermatorrhœa with hyaline cylinders, a little broader than the renal cylinders.

Not knowing of the existence of hyaline cylinders in spermatorrhœa, I thought I had to discover a disease of the kidneys, and made the most careful search in that direction.

In the case of a tailor, thirty-eight years of age, with spinal irritation and total impotence, these cylinders were quite numerous; they could not be distinguished from renal cylinders.

PLATE 64



Mezger lith.

Hyaline cylinders in spermatorrhoea,
so called testicle cylinders.

Peyer's microscopy.

PLATE 65.

SPERMATIC FLUID IN RELATIVE ASPERMATISMUS.

ASPERMATISMUS.

In connection with the various forms of spermatorrhœa we will discuss here, also, shortly the chapter of male sterility, so far as it does not result from *impotentia coëundi.*

We distinguish aspermatismus and azoöspermia. With the former we count those cases where, with more or less normal production of semen, its ejaculation during the coitus is prevented.

Of this condition we find several forms:

1. *Absolute aspermatismus* is generally the result of a mechanical impediment for the passage of the semen into the urethra. These mechanical impediments owe their origin generally to gonorrhœa. There is in these cases no possibility of an ejaculation.

2. *Relative aspermatismus*, without any ejaculation in coitus; neither by long-continued manipulation (onanism). During sleep, however, with sensual dreams, pollution of normal seminal fluid takes place. This form is congenital; we find usually no anatomical changes, and have so far no explanation.

3. *Temporary aspermatismus*, when ejaculation fails at certain times and under certain circumstances, while at other times it results easily. This depends on position during the coitus, or on the woman with whom it is attempted. As a rule, the affection exists in persons who suffer from irritable debility of the genital organs.

4. *Onanismal aspermatismus*, as I would call a form which I have occasionally observed, but which is not mentioned by the authors. It occurs in men who have masturbated considerably during their youth, with the consequence that the irritation caused by the frictions of the natural intercourse are not able to induce an ejaculation. The member becomes flaccid before it takes place. I had for a considerable time a robust man, the father of six healthy children, under my treatment. With him the ejaculation never took place naturally, but, after having made a number of frictions in the vagina, he had to take his member out, work it *per manum* until the ejaculation threatened, and then quickly reintroduce it. The other men suffering from this kind of aspermatismus practiced the same methods.

Plate 65 gives the picture of a seminal ejaculation in relative aspermatismus. It resembles in all parts a normal, fecund semen.

PLATE 65

Mezger lith.

Spermatic fluid in relative aspermatismus.

Peyer's microscopy.

PLATE 66.

SPERMATIC FLUID IN AZOÖSPERMIA.

AZOÖSPERMIA

Is the form of male sterility where, with well-preserved capacity of coition and normal ejaculation, the liquid contains no spermatozoids.

Causes.—1. This form occurs in robust young men with normal testicles, without any previous disease, without demonstrable cause.

2. It occurs quite frequently in retention of the testes, or where they have been arrested in their development.

3. In parenchymatous disease of the substance of the testicles, as well as in neoplasms which lead to atrophy.

4. In obliteration of the seminal ducts, principally the result of gonorrhœal epididymitis. Liégois found but eight in eighty-three cases of double gonorrhœal epididymitis that did not become definitely sterile.

5. General diseases may, by weakening the organism, cause the absence of spermatozoa; thus Levin found but ten times spermatozoids in persons who had died from tuberculosis. We may find temporary azoöspermia of this character in healthy individuals who are suffering from excesses.

PLATE 66

Mezger lith.

Spermatic fluid in azoospermia.

Peyer's microscopy.

PLATE 66.

SPERMATIC FLUID IN AZOÖSPERMIA.

GENERAL REMARKS ON THE SPUTUM.

The sputum has played a considerable part in the doctrine of disease, even before the introduction of the microscope. Many views have naturally undergone great changes since we can accurately recognize the several morphological parts of the sputum, and of late it has proved a prominent help in the diagnosis of lung diseases, notwithstanding the advanced technical aid of physical examination.

We say help, for generally we employ the microscopic examination of the sputum only to confirm a diagnosis which to auscultation and percussion may still be doubtful. I mention this mainly with regard to the elastic fibers in the sputum of phthisis.

In rare instances we may, by the discovery of these morphological peculiarities, be enabled to make a diagnosis in advance of that possible by auscultation and percussion.

The microscopic examination of sputum has, however, as already remarked in the preface, acquired an additional importance since the discovery by *Koch* of the tubercle-bacillus.

Every well-informed physician must know it, and be able to demonstrate it; for it enables us to recognize phthisis in its first initial stage, which early discovery is of great importance in many cases for its curability.

Chemical examination of the sputum, which so far has no diagnostic value, is not practiced. With the microscope we find the following constituents in the sputum:

1. Blood- and pus-corpuscles.
2. Epithelium (pavement, round, pigmented, and fatty-degenerated epithelium).
3. Fat-globules.
4. Detritus.
5. Elastic fibers and lung-shreds.
6. Fibrinous bronchial coagula.

7. Myelin and corpora amylacea.
8. Crystals.
9. Pigment.
10. Bacteria.
11. Accidental admixtures.

Biermer, whose work on the subject is so far the model, divided them in the following manner:

1. Mucous sputum; it is transparent, tough, colorless, poor in cellular elements, and occurs principally in acute catarrh.

2. Purulent sputum; it is greenish yellow, fluid, and, under the microscope, we only see numberless pus-corpuscles. It occurs generally in pulmonary abscess or abscesses in the surrounding parts, or in chronic bronchitis.

3. Muco-purulent sputum (sputum coctum); we find it in the later stages of bronchial catarrh. To this class belong the coin-shaped sputum and the globular sputum, which is also called cavernous sputum.

4. Bloody sputum. (See Plate 77.)

5. Serous sputum; a fluid, foaming mass, peculiar to œdema of the lungs.

The *color* of sputum partly reveals its chemical composition.

It is *transparent* when it contains few morphological elements, and it is solely mucous.

A purulent sputum is greenish to *yellowish green*. It turns *red* on admixture of blood.

By transformation of the hæmatoidin the color may turn *brownish red* to *green*.

Bile-pigment in the sputum will also color it *green*.

It turns *black* by admixture of coal-dust.

The bacteria of the pigment may cause accidental coloring, such as *yellow* or *green*.

PLATE 68.

ACCIDENTAL CONSTITUENTS OF EXPECTORATION.

10

ACCIDENTAL ADMIXTURES OF EXPECTORATION.

Before discussing specially the sputum, we will mention accidental admixtures. They are principally remains of food, which may even cause diagnostic errors, when, for want of practical experience, muscle-fibers may, e. g., be taken for parts of the lung; small bread-crumbs are frequently found in muco-purulent sputum; the amylum grains are then swelled and present a pretty aspect. Generally, however, these admixtures are so characteristic that they may only confuse an inexperienced examiner.

PLATE 68

Mezger lith

Accidental constituents of expectoration.
(Muscular fibres and amylum grains).

Peyer's microscopy.

PLATE 69.

TONSILLAR AND MUCOUS BRONCHIAL PLUGS.

MUCOUS BRONCHIAL PLUGS.

Occasionally we find the follicles of the tonsils after acute inflammation closed by white plugs; or this plugging appears as an independent chronic disease, which, by a constant irritation, causes a continual desire to cough and hawk.

Microscopically, these plugs consist of a granular mass of detritus in which are imbedded:

Large numbers of different-sized needles of *margaric acid;*

Fat-globules from the smallest to the largest size;

Pus-corpuscles in a state of dissolution;

Threads of *leptothrix*, partly without any regular arrangement, conglomerated with the detritus, or else in the form of beautiful large sprays; finally,

A *colony of micrococci* in half-moon shape.

These same plugs, only much larger, are found in the sputum of putrid bronchitis and pulmonary gangrene; it collects at the bottom of the vessel in the form of brittle gray masses of various sizes. The largest are of the size of a bean; they are then called "mycotic bronchial plugs."

PLATE 69

Mezger lith.

Mucous bronchial plugs.

Peyer's microscopy.

EXPECTORATION IN CATARRH OF MOUTH AND PHARYNX.

We have two forms of epithelium in the respiratory tube, including mouth and pharynx—i. e., pavement and ciliated. The latter is rarely found in the sputum, even in severe inflammation of the bronchi. The pavement epithelium occurs, however, almost without exception, in expectorated matter. It may be in very large quantities in catarrh of the mouth and pharynx. Corresponding to the two layers of the epithelium we distinguish the large, often polygonal, epithelium of the upper layer and the smaller round epithelium of the lower layer; the latter can not be distinguished with certainty from the epithelium of the alveoli of the lung.

An expectoration due to a catarrh of the mouth and pharynx is in most cases rich in large pavement epithelium. Such catarrhs are mainly found in persons who neglect the care of their oral cavity and labor much in fine dust.

Plate 70 is the drawing of the sputum of a saddler who in a factory constantly works in a dusty room on horse-hair bolstering. In the morning he has a reddish-colored expectoration, containing, in addition to large quantities of pavement epithelium, red and white blood-corpuscles, sarcine, leptothrix threads, and generally bacteria.

Nauwerk, who has observed four cases of sarcine in the sputum, believes that it originates from the pharynx, and ascribes to it no importance.

PLATE 70

Mezger lith.

Leptothrix threads and sarcine
in catarrh of mouth and pharynx.

Peyer's microscopy.

PLATES 71 AND 72.

CHRONIC BRONCHITIS.—PIGMENT IN THE SPUTUM.

CHRONIC BRONCHITIS.—PIGMENT IN THE SPUTUM.

While in the acute stage of bronchitis a mucous condition of the sputum is predominating, it assumes in the chronic stage a muco-purulent or entirely purulent character. At times we find in such sputum large quantities of pulmonary epithelium, and may judge, when this condition constantly occurs for some time, that irritation of the lung exists.

Von Buhl diagnosticated the so-called desquamative pneumonia (Plate 75) when in addition to the above he found myelin. Frequently the epithelium is in a condition of fatty degeneration, or covered with black pigment. This exists in the form of more or less fine dust-particles, which either fill the whole cells uniformly, causing a homogeneous black coloring, or else they are deposited in certain places, leaving others free.

The black pigment must always be considered as coal-dust, which had been held by the mucus of the respiratory tract, and finally received into the interior of the cells.

This dust, when inhaled for a considerable length of time, may occasion inflammation. The group of diseases caused by inhalation of dust is called pneumono-koniosis. It occurs also frequently in persons who work in fine iron-dust.

A transient gray and black sputum is found in persons who have passed the evening in dusty and smoky rooms.

Workmen in paint factories also suffer from this disease; cases are known where the sputum was colored blue by inhalation of ultramarine.

In the organism itself a pigment is developed which colors the expectoration yellowish brown to brown.

The sputum may be colored (Plate 72) by modified blood-pigment, either being expectorated after hæmorrhages of the lungs in the form of pigment-scales and crystals of hæmatoïdin, or else being absorbed by the pulmonary epithelium, and thus appearing in the sputum. This pigmented epithelium is quite frequently observed in tubercular and pneumonic expectoration; it is, however, principally almost pathognomonic of insufficiency and stenosis of the mitral valve.

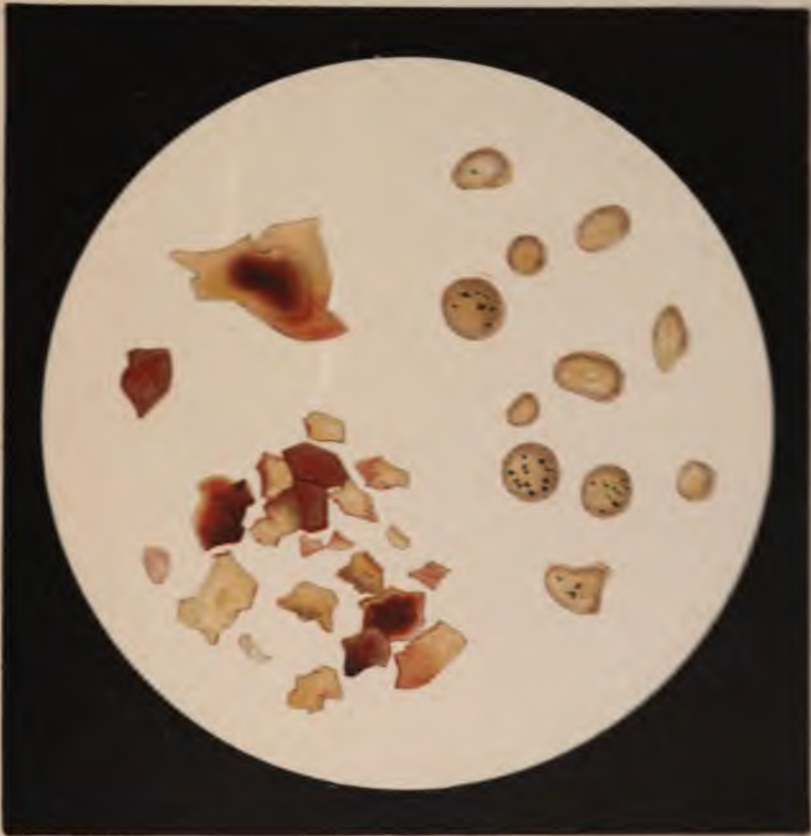
PLATE 71

Mezger lith.

Chronic bronchitis.

Peyer's microscopy.

PLATE 72



Mezger lith.

Epithelium pigmented yellow,
pigment scales and crystals of hematine.

Peyer's microscopy.

PLATE 78.

BRONCHIECTASIS.

BRONCHIECTASIS (CRYSTALS IN SPUTUM)

Is in many cases the result of chronic bronchitis. The sputum is muco-purulent, and, especially in the morning, very copious. In consequence of stagnation, it easily acquires a penetrating odor, and under the microscope shows beginning decay.

Plate 73 represents a light case of dilatation of the bronchi. The expectoration, which, especially in the morning, came by the mouthful, had a decidedly fetid odor.

The numerous round epithelial cells are more or less in a state of fatty degeneration. Part of the pus-cells are broken up and form a mass of detritus in which are imbedded numbers of fat-globules originating from the broken-up leucocytes and large, irregular forms of triple phosphates.

The latter are notably always to be found where, in the presence of magnesium, ammonia is liberated by the putrefaction of nitrogenous compounds; they are the principal form of crystals found in the sputum. As rarer occurrences I will mention the neutral calcium phosphate which I found *once* with beautiful, regular coffin-shaped crystals in sputum; I refer here to Plates 18 and 19.

I also found in *one* case only beautiful crystals of calcium oxalate. (See Plate 12.)

The crystals of *cholesterin* are more rare; they appear in the form of thin, colorless, rhombic tables, easily soluble in ether, but insoluble in water, acid, and alkalies; *Biermer* and *Eichhorst* found them in tubercular sputum, *Leyden* in an abscess of the lung.

Crystals form in the expectoration whenever it stagnates in the lung; their presence, however, has neither diagnostic nor practical importance.

PLATE 73

Mezger lith.

Bronchiectasy.

Peyer's microscopy

PLATE 73.

BRONCHIECTASIS.

BRONCHIAL ASTHMA.

The sputum is muco-purulent, often somewhat frothy; it usually contains quantities of round epithelium, sometimes some blood, by which it is reddened.

In a number of cases we observe the occurrence of the so-called asthma crystals. They have the form of a whetstone, and are of different sizes; they are colorless, opalescent, and consist, according to Salkowski, of a crystallized substance resembling mucin.

Unger has never failed to find these crystals in the sputum of twenty-three asthmatic persons; as to myself, I have found them but twice in ten cases.

Myelin-corpuscles are not rare either in this sputum. Plate 74 originated from a professor, thirty-seven years old, suffering from bronchial catarrh, to which asthma supervened, which lasted about three weeks continually. During all this time large and fine crystals could be demonstrated in the sputum, but not in such quantities as in another case, a baker, fifty years old, when the abundant expectoration actually bristled with these crystals like the spines of a hedgehog.

Leyden considers these crystals as peculiar to asthma; my observations do not agree with him. I have found them also in a case of pulmonary gangrene without asthma. Bizzozero, of Turin, found them also repeatedly in his own expectoration while he was affected only with a slight bronchial catarrh.

PLATE 74

Mezger lith.

Charcot-Neumann crystals.
(Asthma crystals of Leyden).

Peyer's microscopy.

PLATE 75.

MYELIN AND CORPORA AMYLACEA.

MYELIN AND CORPORA AMYLACEA.

In connection with the asthma-crystals we will mention here the occurrence of a peculiar element in the sputum, viz., myelin. It had been observed by *Virchow*, but *von Buhl*, of Munich, first attributed to it considerable importance, as, when present in abundance, it is pathognomonic of the so-called desquamative pneumonia.

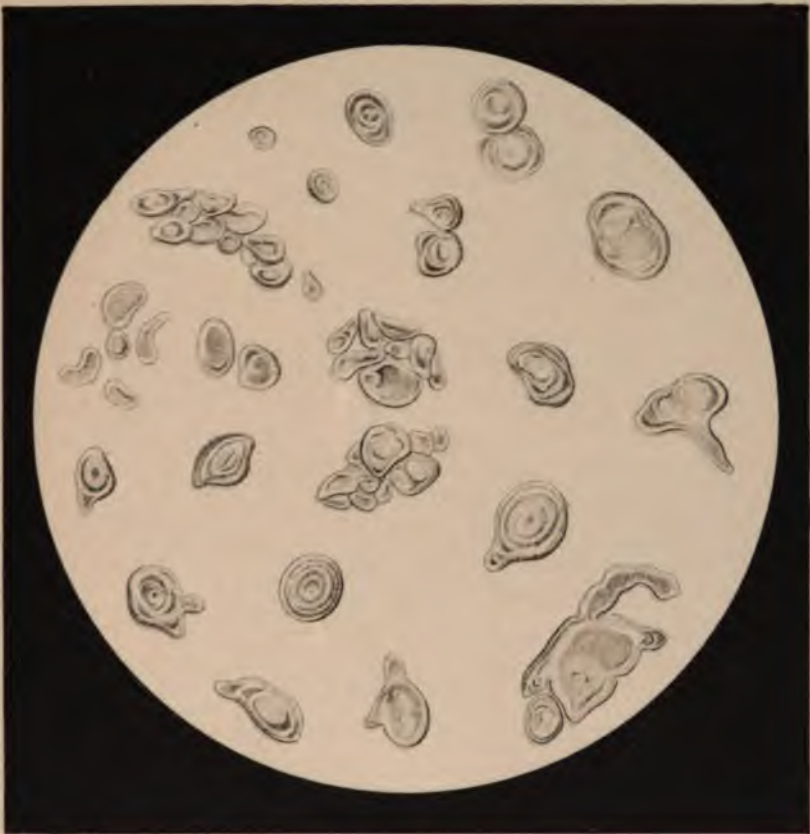
This theory is, however, entirely contradicted by the fact that myelin can be found in the expectoration of absolutely healthy persons, especially in the morning sputum. It is found likewise in large quantity in the sputum of chronic bronchitis.

Myelin consists of round, oval, or pear-shaped bodies, which are easily recognized by their double contours and opalescent hue. Their size varies much—from less than that of a pus-cell to larger than pulmonary epithelium.

There are several views as to their origin. The one attributes it to alveolar cells after fatty degeneration; others as transformed from the shape of ordinary migratory cells.

The myelin on Plate 75 is taken from the sputum of a strong, healthy, and blooming girl, who expectorates only mornings. On the slide it appears as minute white dots, which, under the microscope, consist of large myelin granules of various forms. We see especially larger individuals with absolutely concentric arrangements, and, according to our conviction, these are the so-called corpora amylacea, or amyloid grains, which are found so rarely, and which have first been mentioned by *Friedreich*, and are supposed to be the result of the transformation of cells.

PLATE 75



Mezger lith.

Myeline and so called amylaceous bodies.

Peyer's microscopy.

PLATE 76.

CHRONIC CROUPOUS OR PLASTIC BRONCHITIS.

CHRONIC CROUPOUS OR PLASTIC BRONCHITIS

Is very rare as an independent disease.

Biermer mentions a case of a robust student of medicine who expectorated from time to time perfectly formed fibrinous casts, and bore his disease without great inconvenience.

The preparation of Plate 76 originated from a strong and robust miller, fifty-four years old, who expectorated these casts three months prior to his death, up to within four days of it, in copious quantities. At the autopsy the bronchi of the right side were found dilated throughout, but neither spindle-shaped nor saccular bights. There was nowhere a trace of fibrinous cylinders; the mucous membrane was dark and livid.

The coagula are usually grayish white. Microscopically, they appear formed of fibers running longitudinally. Blood- and pus-cells are imbedded in them; occasionally, also, epithelium.

PLATE 75

Mezger lith

Chronic croupous bronchitis

Peyer's microscopy.

PLATE 77.

PULMONARY HÆMORRHAGE.

11

BLOODY SPUTUM.

Nothing causes to the layman so much anxiety as the appearance of blood in the sputum, and no question is propounded to the physician as often as this: "Where do you believe that the blood in my sputum comes from?"

We distinguish, first, a *pure bloody* sputum. In this case we have first to decide if it originates from stomach or lungs. This question can not be answered easily in every case; in some it is very difficult, in others totally impossible.

In hæmorrhage from the stomach the blood is usually very copious, black, or chocolate-colored; its reaction is sometimes acid through admixture of the contents of the stomach, and, with the microscope, we may recognize particles of food.

In pulmonary hæmorrhage the macroscopic appearance is important; the blood, by its coagulation, forms a regular cake, which may contain many air-bubbles, thus giving it the resemblance of a sponge. Generally it is sufficient for the diagnosis to ascertain if the blood was carried out by vomiting, coughing, or in any other manner.

Still it may occur that on vomiting blood part of it enters the larynx and causes cough, thus simulating pulmonary hæmorrhage; or that, *vice versa*, in a pulmonary hæmorrhage much blood has been swallowed and then vomited, and therefore diagnosticated as hæmorrhage from the stomach.

Blood from *nose*, *pharynx*, and *oral cavity* frequently flows into the larynx unnoticed and causes a bloody sputum.

Hæmorrhages from *trachea* and *larynx* are rare; those from the *bronchi*, however, frequent; they may be brought about by severe paroxysms of cough. When the sputum is only *tinged* with blood, this latter is admixed in the form of small dots or streaks; it may occur in bronchial catarrh. Repeated and continued appearance is suspicious as a symptom of phthisis.

The expectoration closely mixed with the sputum shows the blood-corpuscles well distributed among the other elements of the

PLATE 77

Mezger lith.

Pulmonary Hemorrhage.

Peyer's microscop

expectorated matter, and can only occur when blood and the rest of the sputum had been in contact for a considerable time, and thus had opportunity to mix closely.

Plate 77 shows such a sputum of a patient with apex catarrh; it is muco-purulent, and contains pus-cells, pigment-scales, and epithelium, in addition to the fresh blood-corpuscles.

PLATE 78.

ELASTIC FIBERS IN SPUTUM.

ELASTIC FIBERS IN PHTHISIS.

The principal structures found in the sputum of tuberculosis are elastic fibers. Observers somewhat trained will find the places in the expectoration, where they occur, with the naked eye; they are darker points, which may be seized with the pincette and placed under the microscope.

They are easily recognized by their double outlines and noose-shaped arrangement.

Chemically they show great resistance to caustic alkalies. It is not easy for the beginner to distinguish admixtures of the sputum, such as cotton fibers, from the elastic fibers; margaric-acid needles, when they have double contour and occur in curved shape, may also cause mistakes. The latter, however, dissolve on slight heating. As a rule, elastic fibers should only be diagnosticated when several adhere together.

At times we find larger pieces of the lung-tissue, comprising several alveoli (lung-shreds). (See Plate 80.)

PLATE 78

Mezger lith.

Elastic fibres in phthisis pulm.

PLATE 79.

TUBERCLE-BACILLUS.

THE TUBERCLE–BACILLUS.

The demonstration of tubercle-bacilli by Koch in the sputum of phthisical persons is one of the most important diagnostic discoveries of the present age.

The bacillus of tuberculosis exists not alone in general tuberculosis, but also in cases where the disease remains localized for a long while, and finally disappears. We have learned thereby that such light and benign cases, which formerly we tried to separate from genuine tuberculosis, really belong to this disease; that by the discovery of the bacilli we are enabled to make a diagnosis of tubercular disease in the lungs in those light cases also where formerly it was impossible.

That such favorably resulting tubercular diseases are very numerous can be established at the post-mortem table, where one half of the robust individuals who had died from accidental sickness show in their lungs traces of tubercular disease in the form of cheesy masses, often incrusted with lime, and surrounded by slate-colored, indurated cicatricial tissue.

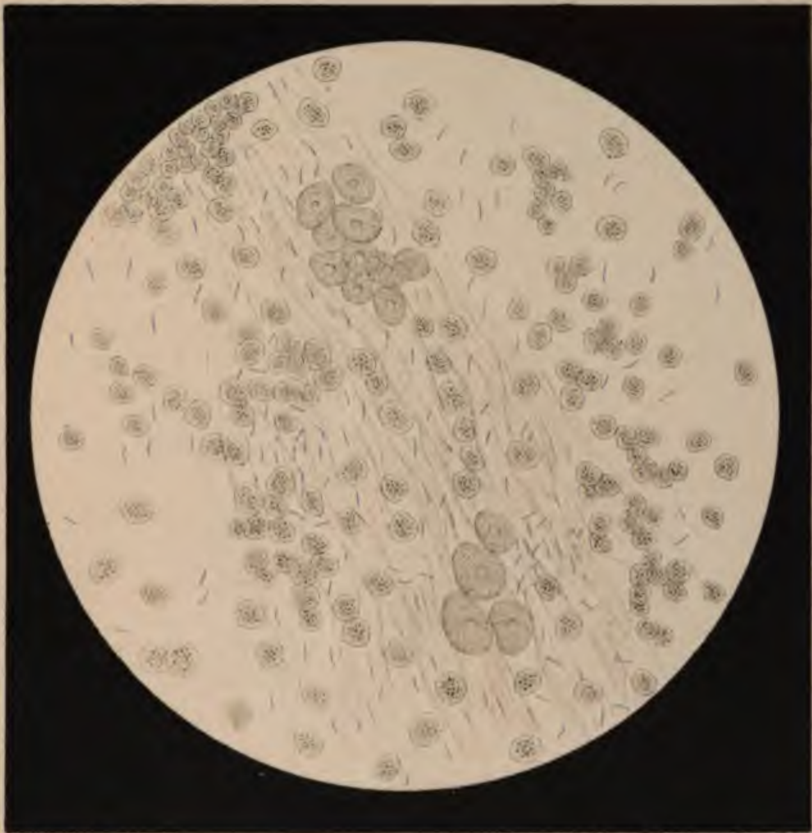
Many of these cases remained latent; but in all of them we might at some stage have demonstrated tubercle-bacilli in the sputum.

Every physician knows that these apparent convalescent or even latent cases may suddenly terminate in a tubercular pleurisy, or even meningitis.

We must, therefore, always, on discovery of these bacilli in the sputum, make the prognosis grave, but not absolutely fatal.

On the other hand, the constant absence of tubercle-bacilli will be a sure sign that no tubercular destruction of the lung exists. As the disease increases in intensity so does the appearance of bacilli in the sputum become more constant, and they grow in numbers and size. A suspicious sputum giving negative results should be examined during at least four successive days before a positive opinion can be given that no bacilli exist, consequently no tuberculosis.

PLATE 79



Mezger lith.

Tubercle bacilli.

Peyer's microscopy.

PLATE 79.

TUBERCLE-BACILLUS.

PLATE 80.

PULMONARY GANGRENE.

PULMONARY GANGRENE.

This is at once recognized by the insupportably putrid smell with which such a patient pollutes the air.

Its sputum reveals under the microscope the following parts:

1. Elastic fibers which, however, are already in a state of solution. *Traube* first drew the attention of observers to the fact that in pulmonary gangrene the fibers are at times entirely dissolved; he considered this as a diagnostic criterion against pulmonary abscess, where the elastic fibers are longer preserved.
2. Numerous pus-corpuscles already partly disintegrated.
3. Pulmonary epithelium, mostly in a high state of fatty degeneration.
4. Myelin in various forms.
5. Leyden's asthma crystals, numbers of small ones imbedded in detritus.
6. Needles of margaric acid, at times in perfect form, also imbedded in detritus.
7. Fat-globules of various sizes.

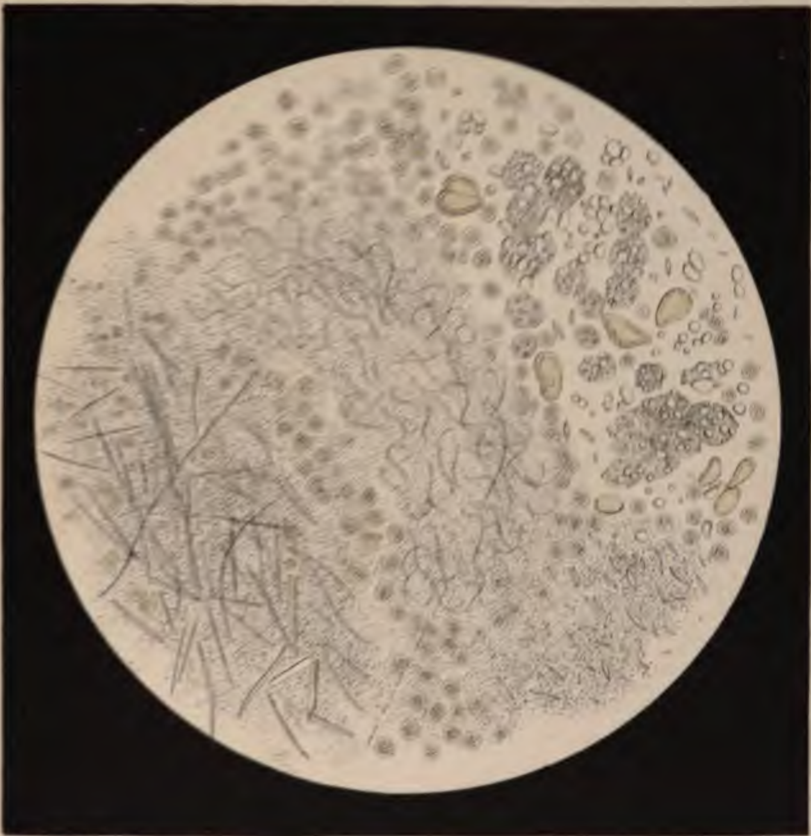
Differential diagnosis between putrid bronchitis and pulmonary gangrene can only be established by total absence or permanent presence of elastic fibers in the sputum.

PULMONARY ABSCESS

Discharges an ordinary pus in abundant quantities; the putrid smell appears only when for some cause the secretion is retained, or on transition to pulmonary gangrene.

Under the microscope we find elastic fibers in alveolar arrangement; masses of fat-crystals, pigment-scales, and hæmatoidin crystals; at times also plates of cholesterin.

PLATE 80



Mezger lith.

Pulmonary gangrene.

Peyer's microscopy.

PLATE 81.

ABSCESS OF LIVER WITH PERFORATION THROUGH LUNG.—
EXPECTORATED MATTER.

ABSCESS OF LIVER WITH PERFORATION THROUGH LUNG.

Mr. B., a merchant, thirty-six years of age, returning, after a sojourn of eleven years in Batavia, with an affection diagnosed as "right-sided pleuritic exudation," exhibited, during a stay in a hydropathic establishment, suddenly abundant expectoration of a dirty reddish color and penetrating odor.

Several physicians hesitated between the diagnosis of pulmonary abscess and hepatic abscess perforating the lung, but for several reasons they inclined more toward the supposition of a pulmonary abscess.

Microscopic examination of the expectoration, which had an intense smell of garlic, decided me in favor of hepatic abscess, and the post-mortem eventually confirmed the correctness of my view.

The sputum consisted of a reddish-gray mass of detritus, in which we distinguish the following elements:

Numerous pus-corpuscles, partly well preserved, partly disappearing.

Masses of fat-globules of various sizes.

Large, round cells in fatty degeneration, probably liver-cells.

Elastic fibers from the lungs.

About an hour after preparation there appear great numbers of brushes of tyrosin and opalescent globes of leucin in various sizes.

These leucin-globes can easily be distinguished from the fat-molecules, the latter being strongly refracting, with sharp contours, while the former appear dull, with indistinct outlines.

Leucin and tyrosin do not occur in crystalline form in fresh sputum, but crystallize only after standing or when it commences to dry.

The demonstration of tyrosin is, according to *Kanneberg* (Leyden's Klinik), of value for the diagnosis of abscesses which from outside have penetrated the lungs.

Leyden once observed leucin and tyrosin in a young man who was suffering from putrid bronchitis.

PLATE 81

Mezger lith.

Abscess of liver with perforation through lungs.

Peyer's microscopy

CHAPTER V.

MICROSCOPY OF THE STOOL.

MICROSCOPY OF THE STOOL.

We find in every stool remains of—

1. *Vegetable Food.* Cellulose is most indigestible. It forms the frame of the vegetable form-elements, and can easily be recognized in its characteristic shape. Young vegetables alone are entirely digested.

2. *Muscular fibers* are often found numerous in intestinal catarrh; they are tinged intensely yellow; many show still plainly the longitudinal or transverse striping; the transverse disappears first, and in its place we see a fine granular appearance. Later the outlines are rounded off, and form oval bodies in which the granular appearance fades away, leaving intensely yellow, homogeneous, roundish scales.

3. *Fat* is found almost constantly, even in normal stools, mostly in the form of globules.

4. More rarely in the form of crystal-needles, which are united in the shape of brushes or globular aggregation.

5. *Granular detritus* may be demonstrated almost in every stool. It is a sign of good digestion the more the granular detritus preponderates over cellular parts.

6. *Blood-corpuscles* perish rapidly in the intestine, and they can, therefore, often scarcely be demonstrated in fecal discharges of bloody appearance. They can only be recognized when the blood originates from the lower part of the large intestine, and is soon evacuated. When a copious hæmorrhage has taken place in the intestine, as in gastric ulcers, the blood is evacuated as a thin, pitch-like mass, in which blood-corpuscles can no more be recognized; they appear then in the form of scales, as represented in Fig. 6, Plate 82.

7. *Mucus* occurs in larger quantities only in pathological stool; it either coats the intestinal contents or is mixed with them; at times the stool consists of mucus alone, and the pieces are so large that they simulate the appearance of shreds of intestinal lining. In these cases we find under the microscope white blood-globules imbedded in gelatinous substance.

PLATE 82

Mezger lith.

Intestinal contents.

Peyer's microscopy.

8. *Crystals.* The triple phosphates are most frequent, even in normal stools, and independent of their reaction; they are seen in beautiful forms. Neutral calcium phosphate, calcium oxalate, cholesterin, and Charcot-Leyden crystals may be found, but rarely.

9. *Epithelium* appears mainly in the cylindrical form; it is abundant in acute enteritis with diarrhœa.

10. *Algæ.* *Bacterium termo* is most frequent; it is a delicate bacillar formation, either free or in zoöglœa conglomerations. *Sarcinæ ventriculi* occur in the stool when they are abundant in the stomach. *Yeast-cells* also appear frequently. The single cells are round or oval, colorless or slightly tinged, and exhibit in their interior one or more nuclei.

INTESTINAL WORMS.

ROUND-WORMS (*Nematelmia*).

The *maw-worm*, *Ascaris lumbricoïdes*, round-worm (1, 1 *), is common, widely disseminated; lives in considerable numbers in the small intestine; may also pass occasionally into other parts of the body. The injuries caused thereby may occasionally, but rarely, become dangerous. It resembles in shape the ground-worm, and its length is up to thirty centimetres. Its dirty white, sometimes pink, skin is delicately striped transversely, interrupted by two lateral lines; three distinct tubercles surround the mouth. The worm does not pass off regularly or spontaneously with the fæces; we have then to search for the eggs, which, on presence of the worm, are expelled in large quantities with the alvine evacuations. They are short, oval, about seventy μ long, but appear larger owing to a thick, tuberculated, brownish covering of albumen.

The *thread-worm*, *Oxyuris vermicularis* (2, 2 *), inhabits chiefly the rectum in large masses, and, when passed in a living condition, exhibits a lively, springy motion. The female, which may be recognized by its finely pointed tail-end, grows to be more than one centimetre long; the male, half as long and much more rare, has a blunt tail-end, curved in the shape of a hook. The head is wider, unarmed. The diagnosis can easily be made from the constant passage of the worms with the stool or otherwise; the eggs are unnecessary for this purpose. (They are äsymmetric, fifty μ long, and contain generally a plainly perceptible embryo.)

The *whip-worm*, *Trichocephalus dispar* (3, 3 *), occurs over a large area, and in some places is frequent. It inhabits the cæcum, rarely in considerable numbers. It has a peculiar shape; the anterior two thirds of its body are filiform, while the tail-end is considerably thicker—in the male rolled up in spiral shape, in the female only slightly curved. Its length is four to five centimetres. The eggs (necessary for the diagnosis) are about the size

PLATE 83

Intestinal worms with ova.

Peyer's microscopy.

of those of the oxyuris, and are well characterized by plug-shaped extremities.

The *hook-worm*, *Anchylostoma duodenale* (4, 4 *), appears less to inhabit the duodenum than the jejunum, where it hooks itself fast and sucks blood. It is at home only in warm climates, and has been known in middle Europe but since the building of the Gothard tunnel. It is somewhat larger than oxyuris, and its mouth is armed with three pairs of slightly hooked teeth; the tail-end of the female has a short point; that of the male has a bell-shaped dilatation, from which usually the two thready penes (spiculæ) are seen protruding. The eggs are necessary for the diagnosis; they pass with the stool and are about the size of those of the oxyuris, and are usually found in the stage of vitelline segmentation.

Trichina spiralis (5, 5 *).—The eggs produced by the mature animal, the intestinal trichina, do not pass off, but develop in the bowel to small worms, which immediately commence their migrations, and, on arrival in the muscles, become encysted. It is necessary, therefore, in order to demonstrate the trichina, to find the worms, which, however, are very small and slender (the female at most three millimetres long, the male barely half that size), and rarely pass off whole; only well-trained and persistent observers will be successful. It is easier to discover the muscular trichinæ, especially when they are encapsuled, although they are smaller, at most one millimetre long, the capsule 0·5 to 0·7 millimetre. When these capsules are not visible on the under surface of the tongue it may be necessary for microscopic investigation to remove a piece from one of the muscles of the extremities.

The *liver-fluke*, *Distoma hepaticum* (6, 6 *), one of the principal parasites of the sheep, is found, although rarely, in the human being, usually in the hepatic ducts, where, by pressure, it causes inflammatory symptoms. It may also be found in the intestine, and even under the skin (case in Zurich, in the planta pedis). The eggs are necessary to establish the presence of these parasites in

the liver or intestine. They are remarkably large (0·12 millimetre long), colored yellow, and provided with a lid.

The plate exhibits a medium-sized ascaris in natural size, the encapsuled muscular trichinæ enlarged thirty times, the other worms five times. All the eggs are drawn with three hundred and seventy-five diameters (after Leuckart).

PLATE 84.

TÆNIÆ (TAPEWORMS).

TAPEWORMS.

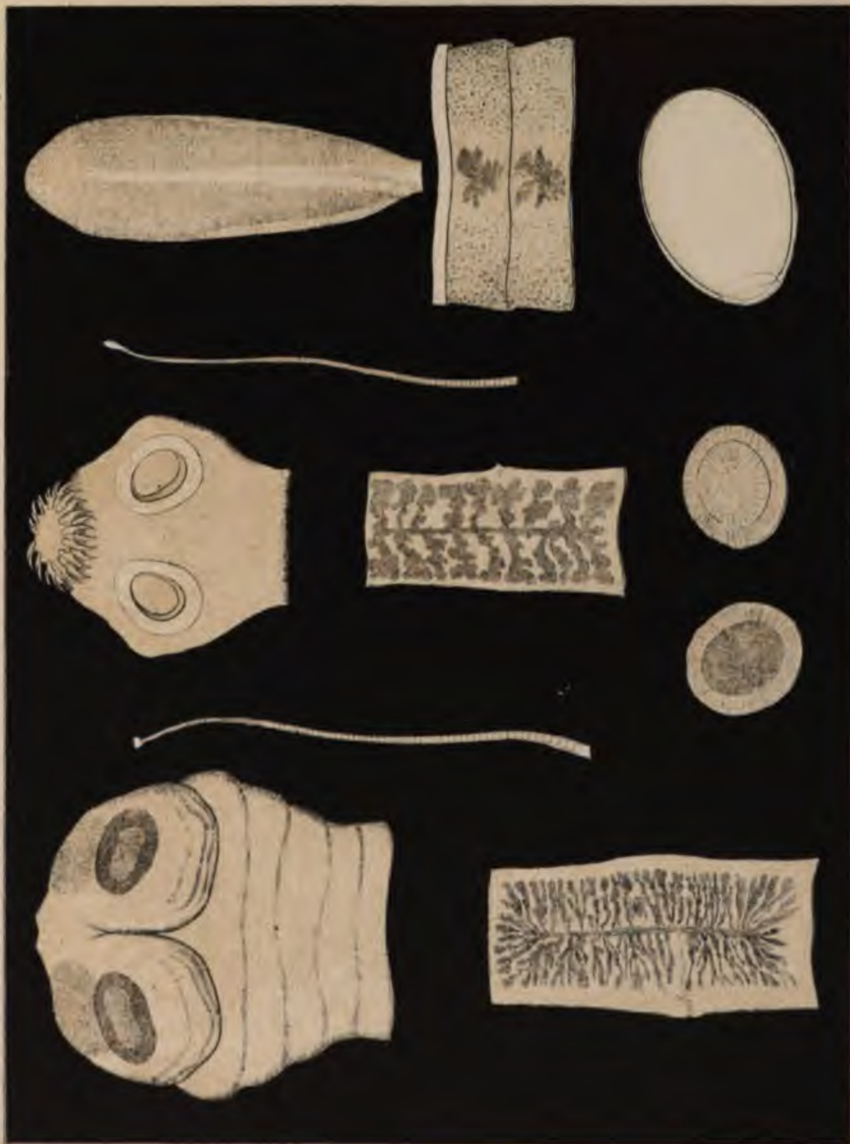
Three species, most important clinically, of tapeworms—*Tænia solium*, *Tænia saginata* (*mediocanellata*), and *Bothriocephalus latus*—distinguish themselves by their size. They are acquired by the ingestion of raw or insufficiently cooked meat containing the eggs (cystic entozoa). *Tænia solium* is the result of the embryo of pork. *Tænia saginata* results from beef, and the pike appears to harbor the larva of *T. bothriocephalus*.

Etiology and geographical location facilitate a diagnosis of probability. *T. saginata* is the tapeworm of the German part of Switzerland (about 12 to 1 solium), south Germany, and of the inhabitants of Asia (who are opposed to the use of pork), of Abyssinia, etc. *Tænia solium* is characteristic of north and middle Germany, North America, etc. *Bothriocephalus latus* is rarely seen in Europe (not so outside of it), with the exception of the coast of the Baltic, in the territory of the Vistula, and along the Lake of Geneva.

The distinction between the three species can be established, even when the worm inhabits the body, by the segments (proglottides) voided, and a timely diagnosis is practically important. For while *T. saginata* and *B. latus* are innocuous, we find the bearer of a *T. solium* dangerous to himself and his surroundings, as the cystic condition of this tænia, the *cysticercus cellulosæ*, flourishes in the human body, where it takes its seat occasionally in the cranial cavity or the eye, and causes great disturbance.

It appears, according to latest observations, that the unarmed cysticercus of *T. saginata* may live in the human body, but these cases are so very rare that this does not alter the peculiar danger of *T. solium*. This latter has, therefore, to be ejected at once, while, with the other species, the treatment may be undertaken at a convenient time. The distinction of the different tapeworms is also useful for the physician, as it influences the mode of treatment. *Bothriocephalus* is most easily removed; *T. saginata* requires the strongest doses.

PLATE 84



Bothriocephalus latus.

Taenia solium.

Taenia saginata.

Intestinal worms with ova.

Peyer's microscopy.

Diagnosis of the Species from the Segments.—I. *Tænia.*—The segments usually pass off singly; they may emigrate in a living condition and lead outside the body a life more or less independent (locomotion and change of form). They are square, in the center somewhat wider, their length equal to twice their width. The sexual aperture is on a little papilla on the *longer* edge. On examining a segment, slightly pressed between two plates of glass, with transmitted light, we observe more or less distinctly a characteristic figure which fills nearly the whole segment; it is the uterus filled with eggs. The appearance is distinct when the uterus is completely filled, which is the rule when several segments adhere together uninjured. When, however, the proglottides are isolated and move in a lively manner, the uterus is hard to recognize, as it is emptied. In such isolated segments there flows from the place of separation a milky liquid which contains the eggs suspended in fluid. The eggs are pale, short, oval bodies, which, beside a remainder of the vitellum, contain the embryo with its six hooklets, inclosed in a round, thick capsule with radial stripes.

We must not be led astray in attempting to diagnose the tænia by its appearance when dead, as the segments are then contracted or shortened. Thus *T. saginata* will exhibit segments resembling *Bothriocephalus.* The lateral position of the sexual aperture removes every doubt. If the head can be obtained it will be the main proof.

(*a*) *Tænia saginata* (*mediocanellata*). — The ripe segments pass off in large numbers and behave with great independence; their length is up to two centimetres. The sexual aperture is on the long edge *behind* the center. The uterus has twenty to thirty lateral branches, generally straight, here and there fork-shaped. The embryonic capsule is roundish oval, its largest diameter forty μ.

(*b*) *Tænia solium.*—The segments pass off more rarely single, generally in small chains, with the fæces, and are only half the size of those of the *T. saginata.* The sexual aperture is almost *in the center* of the long edge. The lateral branches of the uterus, about ten on each side, ramify again, and toward the end are thicker and often coiled up. The embryo is smaller, but barely distinguishable from the *T. saginata.*

II. *Bothriocephalus latus.*—The segments pass, as a rule, in *chains.* The majority of them are much broader than long, even up to fifteen millimetres; a few only of the ripest ones approach the square shape. The genital apertures are located separately in the median line of the surface, not recognizable with the naked eye; the uterus occupies but little space; its characteristic shape has been compared to an armorial lily. The eggs still retained in the uterus contain no embryo, are decidedly oval, of a diameter about ninety μ, the capsules thin and provided with a small cover.

The *heads of the tæniæ* are *globate,* with four suckers.

(*a*) *T. saginata* has a large head two millimetres broad, on transverse section rectangular with rounded edges, with strong suckers, which often are pigmented and appear to the layman as eyes. The neck is broad.

(*b*) The head of the *T. solium* is much smaller (not much more than one millimetre broad), pear-shaped, prolongated into a rudimentary proboscis, surrounded by a double row of hooks. The sheaths covering the hooks are more or less pigmented. The neck is slender.

(*c*) The head of *Bothriocephalus* is elongated, fully two millimetres long, and bears on each side of the lateral border a long sucker in the shape of a cleft. The neck is moderately slender.

The plate exhibits an anterior view of *T. saginata* and *B. latus* in natural size; the proglottides are two and a half, the heads twenty-five, the eggs four hundred times enlarged.

PLATE 85.

COMMA-BACILLUS (CHOLERA).

CHOLERA.*

During a series of examinations made by *Dr. Koch* in East India and Egypt on large numbers of cholera patients and cadavers, and controlling investigations on subjects suffering from other intestinal disorders, he found *peculiar to cholera*, and *constantly present* in the dejecta or intestinal contents, a bacterium which, on account of its peculiar shape, he called "*comma-bacillus*." It would carry us beyond the scope of this book to follow Koch in his reasoning and proofs, and for practical purposes it will be sufficient to give a description and short life-history of the parasite, and the mode of preparation necessary for its demonstration.

In its usual appearance this bacillus resembles a comma and is about one half to one third of the size of the tubercle-bacillus, but plumper and thicker. Sometimes two of these bacilli join endwise and form an S-shaped figure or a semicircle; some appear in screw-shaped spirillum-shape, and appear to be a transition form.

The period of vegetation of these bacteria in the intestine is very short and lasts but a few days. They require for that purpose an alkaline or neutral condition of the fluids, and for rapid propagation a mean temperature of 95° to 104° F.; a lesser degree of warmth retards their progress, and it ceases entirely below 62° F. Freezing does not destroy their vitality, neither does privation of air and oxygen, but their increase is arrested. The following substances in the proportions named destroy the germs: Alum 1 : 100, camphor 1 : 300, carbolic acid 1 : 400, cupr. sulph. 1 : 2,500, quinine 1 : 5,000, corros. sublimate 1 : 100,000.

Drying terminates the life of the bacilli. *Their* propagation is, therefore, dependent on a liquid condition of the vehicle, and they can not be carried by means of the atmosphere in merchandise or mails.

* I have deemed best, and more in accordance with the plan of this book, at the suggestion of the author, to modify the article on cholera, as supplied by Dr. Peyer's manuscript, which is too much of an historical or polemic character, and the purposes of this volume being to represent as a means of diagnosis microscopic appearances as accepted at present date by good authorities. The weight of evidence being in favor of *Koch's* views, they have been adopted, with a mention of the results of other observers. —NOTE BY THE TRANSLATOR.

PLATE 85

Mezger lith. v. Koch.

Cholera.

Peyer's microscopy.

Drinking-water is the usual carrier of the infection. The bacilli do not leave the intestine to pass into the blood; they do not even penetrate the mesenteric glands. *Koch* explains the fatal action as a kind of poisoning of the system caused by the changes of nutrition induced by them.

Similar organisms have been discovered under different circumstances. So by *Lewis* in the saliva, by *Finckler* and *Prior* in cholera nostras; but they do not seem to respond to the characteristic culture-proof of the comma-bacilli of Koch. *Emmerich* discovered other bacteria, said to be peculiar to cholera, in addition to the comma-bacilli, thus not excluding the latter.

Koch's discovery has *practically* the following advantages:

1. It renders an early diagnosis possible, with consequent advantages to hygienic measures.

2. It establishes the fact that the infection dies when in a dry condition.

3. Its natural history gives us valuable hints as to prophylaxis, disinfection, and treatment.

Koch's method of *diagnosis* is based on the culture of the bacillus and its peculiar action on the food-gelatins, different from that of other bacteria.

For the description of this method I will draw largely on a report of *Lewis*, in the "Buffalo Medical and Surgical Reporter" for March, 1885. He acquired his information from Koch himself in his laboratory in Berlin.

The nourishing mediums used for culture of the bacilli are gelatin, bouillon, blood-serum, and potatoes. In all these operations the strictest care must be practiced in the sterilization of vessels and instruments, either by dry heat at 266° F., or steam at 212° F.

The "food-gelatin" is prepared in the following manner: Take ten ounces of lean fresh beef, cut into small shreds, and cover with twenty fluidounces of distilled water. This is to stand twelve hours in a cool place, and then, on being strained through a towel, will yield about ten ounces of fluid. This is heated in the water-bath to body heat, and one and a quarter ounce of stick-gelatin, one drachm of peptone, and fifteen grains of salt are added. It should

be alkaline in reaction. It is now cooked until it acquires the appearance of the white of an egg, and, if it still has the proper reaction, is filtered through filtering-paper and poured into a number of test-tubes (one third full), which are stoppered with cotton and boiled again one hour in the water-bath. This is repeated at the end of twenty-four, forty-eight, and seventy-two hours, and then the gelatin is ready for culture. Another breeding medium is *agar-agar*, "Ceylon moss." Its preparation is similar to that of food-gelatin, except that only one half per cent of gelatin is added. It has to be filtered through a double-walled hot-water funnel. Over food-gelatin it possesses the advantage of not being liquefied by colonies of comma-bacilli.

I quote now *verbatim* from *Lewis*:

"The cultivation of comma-bacilli in bouillon and on the cut surfaces of boiled potatoes will include a description of how these substances are prepared, and I will, therefore, proceed to explain the cultivation in food-gelatin. A small-sized platinum needle is the most convenient instrument with which to transfer materials of this kind, and, after carefully sterilizing the point, remove from the contents of the intestine a single drop, so small as to be scarcely perceptible. Insert the needle into a tablespoonful of food-gelatin in liquid form, and shake it for a few seconds in order to thoroughly distribute the germs in the nourishing medium. From this tablespoonful take a platinum-pointful, and insert it into a second tablespoonful of gelatin, and in a similar manner one from the second into a third, always being careful to sterilize the needle before and after using it.

"We now have three masses of gelatin, each inoculated with the cholera-germ: the first directly from the excrement; the second indirectly from the excrement, having passed through one of the gelatinous masses; the third, apparently quite free from all germs, is still indirectly derived from the excrement, although having passed through two of the gelatinous masses. These are numbered, for convenience, 1, 2, and 3, respectively, and are to be poured upon three plates of ordinary window-glass for the purpose of cooling, and thus rendering them accessible for microscopical examination under a low power. A piece of glass eight inches long and six

inches wide, well sterilized, will be found to serve the best purpose. Exposure to the cold causes the food-gelatin to become hard in a very short time, and the cholera-bacilli, distributed through it, will begin to form colonies in the exact place where they are poured out. In order to prevent foreign matter from entering the gelatin before it has become hardened, the three plates are placed one upon another with an intervening bridge between them, and the whole covered with a bell-jar. Through this mode of development a perfectly safe diagnosis of the comma-bacillus may be made in from twenty-four to thirty-six hours. It moreover facilitates, in a marked degree, a further inoculation in firm, hardened gelatin, or in bouillon, and makes the preparation of colored microscopical specimens a comparatively easy task.

"At the end of twenty-four hours the three plates should be examined under a magnifying power of one hundred diameters. It has been my experience, during Dr. Koch's course, that in twenty-four hours' time only Plate No. 1 gives any satisfactory indications of colony-formation, although I believe this depends somewhat upon the strength of the inoculation. In the early stages of its growth the colony resembles a small white spot upon the yellow background of food-gelatin; its form is nearly circular, with but very little symmetry on account of the rough and jagged appearance of its outline; the center seems to be hollowed out, and here and there a small dark spot may be seen. A little later a very noticeable granulation of its contents takes place, and certain changes in form and size easily distinguish it from colonies of other bacteria. With the gradual growth of the colony this granulation becomes more and more evident, and at last looks like a little mass of strongly refracting granules. During the more advanced stages the gelatin in the immediate neighborhood of the colony undergoes liquefaction and causes the latter to sink much deeper into the gelatinous mass. A funnel-shaped cavity is thus formed, in which the colony is seen as a small, whitish point. This appearance, according to Dr. Koch, is quite peculiar to the comma-bacillus. It is seen, at least, in very few other kinds of bacteria, but never shows itself in such a marked degree.

"The sinking of the colonies can be better observed by carrying

out an artificial cultivation. In order to do this, select a suitable colony, using a magnifying power of one hundred diameters, and, with a fine platinum needle, well sterilized, remove from the colony a small drop and place it in a test-tube of food-gelatin. A cultivation of this kind then grows in the same manner as the colony on the gelatin-plate. At the end of twenty-four hours a little funnel-shaped film marks the place of inoculation, with perhaps a slight extension of the film into the gelatinous mass. This increases more and more until finally the gelatin begins to liquefy around the point of inoculation. Then the little colony extends itself, and at the lower end of the film may be seen a deep spot which gives the appearance of an air-bubble hovering over the colony. Dr. Koch regards the air-bubble appearance as peculiar to the growth of the comma-bacillus, and as identical with the apparent cavity above the white spot on the gelatin-plate. Any number of artificial cultivations can, of course, be made from such a growth, but the same precautions must be observed in all cases in order to insure successful results.

"The mode of cultivating the comma-bacillus in agar-agar jelly is the same as that employed in food-gelatin, and by following out the methods described for the latter a luxuriant growth can be obtained. The fact that the agar-agar is not liquefied by even the advanced growth of the colony renders this substance very valuable as a breeding medium. In potato culture, however, an entirely different process is resorted to. The potatoes should be as fresh as possible, not mealy or in any way discolored, and with few eyes. Those having bruises or scratches that have penetrated the surface should not be used. After carefully washing them and cutting out the eyes, they are to be placed in a five-per-cent solution of sublimate for half an hour. At the expiration of this time they are to be thoroughly cooked in a steam-pot. While they are cooling, the preparator can spend the time profitably in sterilizing half a dozen knives with which to cut them open; he must also wash his hands, but more especially the thumb and first finger, in the sublimate solution. In cutting open the potatoes great care must be taken not to touch the cut surfaces with the fingers, nor should the same knife in any case be used twice. With cut surfaces up, the pota-

toes are placed in a bell-jar, lined with filter-paper, and saturated with sublimate solution. The inoculation should take place immediately after cutting the potatoes, and the method is the same as the one first described. The contents of the platinum point should be spread over the greater part of the cut surface, then inoculated from the first potato into a second, and so on. During the growth of the comma-bacilli upon potatoes the appearance is the same as that presented by the bacilli of glanders. A thin, pulpy, and somewhat brownish coating spreads over the entire surface; the brownish tint, however, is not so intense as in the bacilli of glanders. Comma-bacilli flourish best at a temperature between 30° and 40° C. (86° to 104° F.), although they can be cultivated in temperatures both higher and lower, but their growth is greatly retarded.

"So far I have endeavored to explain the methods of cultivating the comma-bacilli so that they can be examined in colonies under a low magnifying power. No reference, however, has been made to the mode of preparing specimens for microscopical examination under a high power, and for studying the characteristic appearance of the organism itself. For these purposes a bouillon cultivation is the most satisfactory, although dry preparations can easily be made from the colonies as they appear on the gelatin-plate or from the potato culture just described. The bouillon should be fresh and free from all germs, and, before using, should be boiled. A peculiar kind of slide is employed for bouillon preparations; it is of the same size as the ordinary microscopic slide, but the center is hollowed out similar to the cavity of a table salt-holder, thus giving ample room for the growth of the colony. A little vaseline is spread around the edges of this cavity to enable the cover-glass to rest firmly over it. With a sterilized platinum needle place a drop of the bouillon in the middle of the cover-glass and inoculate it with a small drop taken from one of the colonies on the gelatin-plate. Then place the cover-glass over the cavity of the slide, taking care not to have it touch the sides. The vaseline keeps the air out and at the same time serves the purpose of Canada balsam or some other mounting medium. Several slides should be prepared in this manner and then placed in a cool room

for twenty-four hours. They are now ready for examination with the Abbe artificial lighting apparatus and an oil-immersion objective. The appearance presented is that of a swarm of white particles in constant motion; the form is scarcely discernible; now and then, however, their length is seen to be greater than their breadth. An almost infinite number can be noticed, but their violent movements prevent the characteristic "comma" form from being detected. That is, to say the least, an unsatisfactory picture, but the only means of rendering it more real is to apply some artificial coloring substance, such as fuchsin or methyl-aniline blue. From a single bouillon preparation some twelve or fifteen dry specimens can be made. This is effected by carefully removing the cover-glass and inserting a sterilized platinum point into the cultivation. The contents of the platinum point are spread upon a dry cover-glass and a drop of the staining fluid added. After washing off the superfluous coloring matter with distilled water, and mounting the preparation in Canada balsam, the best possible view of the comma-bacillus can be obtained."

Plate 85 represents a preparation of the contents of cholera intestine (after Koch).

a. Nuclei of eliminated epithelium.

b. Semicircular bacillus.

c. Characteristic grouping of the comma-bacilli.

d. Screw-shaped threads (sterile culture of comma-bacilli).

e. S-shaped bacillus (six hundred diameters).

CHAPTER VI.

MICROSCOPY OF CONTENTS OF STOMACH.

PLATE 86.

VOMIT IN CHRONIC GASTRIC CATARRH.

MICROSCOPIC EXAMINATION OF VOMIT.

Mucous or *watery* vomit occurs mainly early in the morning, before breakfast, and is often a symptom of potation (*vomitus matutinus*).

The saliva and mucus secreted in the mouth and respiratory passages are unconsciously swallowed during the night and mix in the stomach with its secretion. This vomit, therefore, contains the form-elements of saliva—pavement epithelium and leucocytes.

The substances vomited in *chronic catarrh* of the stomach, which is frequently complicated with more or less dilatation, are of the most varied nature. The major part is composed of remains of food which have been left for days in the stomach. They can generally be recognized with the naked eye.

The following are the elements recognized with the microscope:

1. *Muscular fibers* in various stages of digestion.
2. *Vegetable parenchyma.*
3. *Amylum grains.*
4. *Fat-globules.*
5. *Mucous shreds.*
6. *Leucocytes* more or less dissolved by the gastric juice. Their nuclei are sometimes alone visible. They originate either from the inflamed mucous membrane of the stomach or from the saliva.
7. *Red blood-corpuscles.* They can be readily recognized if they have sojourned but a short time in the stomach, but soon the hæmoglobin is disintegrated, and its result, the hæmatin, colors the contents dark brown (coffee-ground vomiting in cancer of stomach). The hæmin reaction is then necessary to establish the presence of blood. (See text to Plate 3.)

VEGETABLE PARASITES IN THE STOMACH.

We find, especially in dilatation, when the food has tarried longer than usual, a large number of vegetable parasites. Among them are mainly:

PLATE 86

Mezger lith.

Vomit in chronic gastric catarrh.

Peyer's microscopy.

1. *Bacteria* of the bacillus kind in various lengths.

2. *Sarcina ventriculi.* It closely resembles the sarcina urinæ, is only somewhat larger; when it occurs in greater numbers it may be demonstrated in the stool.

3. *Yeast fungi*, *Torula cerevisiæ*, are cells, either round or oval, single or adherent, of different sizes. They multiply by budding —i. e., they produce a small bud, which, after growing to a certain size, is abscinded. We have to guard against mistaking them for leucocytes or fat-globules.

ANIMAL PARASITES OF THE STOMACH

occur there only accidentally, and mainly originate from the bowel. *Ascaris* is not very rare in the vomit, more so *oxyuris*, and still less frequent *trichina* and *echinococcus.*

Echinococcus is the cystic embryo of a diminutive tapeworm, at most five millimetres long, the *Tænia echinococcus* of the dog. These embryos, which are the result of sexual generation by the mature segments of the worm, assume the vesicular form when they have found a suitable locality, and then go on to various transformations. Some attain only a moderate size; others are distended to an enormous shape; others do not multiply, while the majority develop from their vitelline membrane toward the exterior or interior cysts in the first and second generation, but mainly the small tænia-heads, scolices, from which, under favorable conditions, the reproduction of the little dog-tæniæ results.

The *microscopic demonstration of echinococcus* in sputum, urine, fæces, or abscesses has in every case to be based on the presence of scolices or their hooklets, or the cystic membrane. It is comparatively easy when uninjured cysts are at our disposition, but may become very difficult if only fragments of membrane or contents can be obtained.

The *scolices* have different shape, according to the position of the head. If this protrudes, they are oblong and bear on a short prominence a double circle of hooklets; behind, on an expanded part, the four suckers. When the head is retracted they are globular, and the suckers are hard to recognize, while the hooklets, being

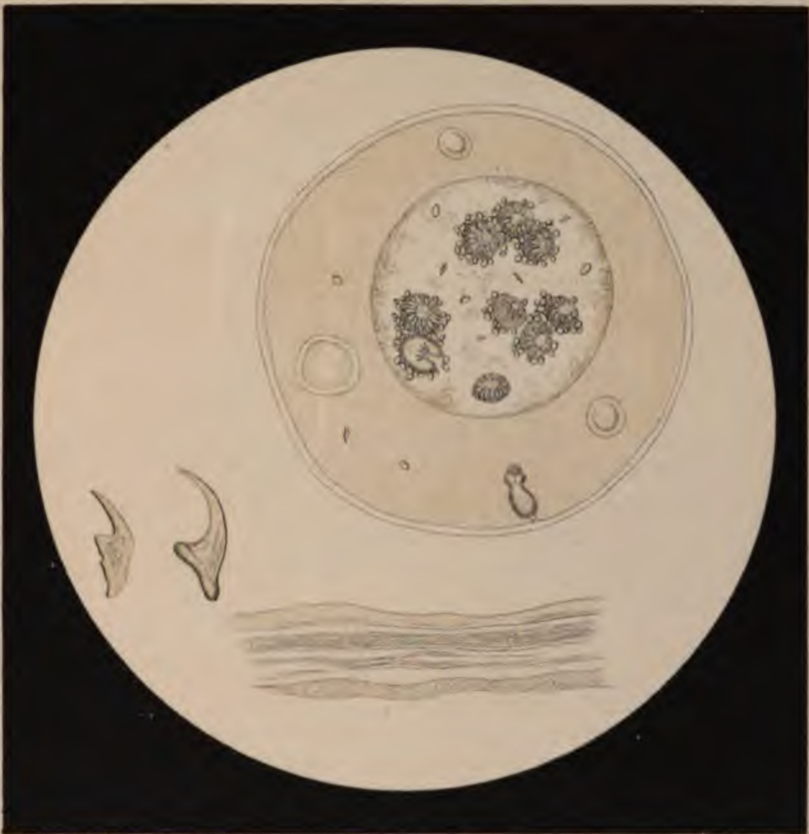
in the center, are easily perceptible. A peripheral deposit of particles of lime often clouds the appearance; the addition of a little acid, which does not affect the hooklets, dissipates this cloudiness. The globular scolices represented in the picture are drawn from a preparation preserved in alcohol; they had a diameter of seventy-five μ.

The *hooklets* of the echinococcus are correspondingly small, not more than twenty-four μ long (those of the pig or the *Tænia solium* are eight times as long). Their form is varied, but approaches the types represented. Their small size and transparency renders their discovery at times extremely difficult, and even under favorable circumstances a magnifying power of five hundred diameters is necessary.

It is, therefore, usually desirable to obtain *membranes* for examination; this is absolutely requisite in the case of acephalocysts —i. e., vesicles non-propagating. The membranes are formed of concentric layers, showing on cross-section a characteristic striped appearance. The striping is much varied; groups of close and distinct stripes alternate, without any regularity, with widely separated pale ones.

The plate exhibits at the top, with a hundred diameters, a small cyst, originating from a daughter-cyst of the size of a filbert. We see a group of retracted scolices with one protruding one; furthermore, isolated hooklets and foundation for new cysts. Below are two hooks and a cross-section of the membrane of that daughter-cyst, the former with six hundred diameters, the latter fifty.

PLATE 87



Mezger lith.

Echinococcus.

Peyer's microscopy.

CHAPTER VII.

MICROSCOPY OF FLUID OF ABDOMINAL TUMORS.

PLATE 88.

CONTENTS OF AN OVARIAN CYST.

CONTENTS OF AN OVARIAN CYST.

They can without the microscope be distinguished from ascitic fluid by the fact that, even after twenty-four hours, they do not coagulate like the latter.

With the microscope we find in the liquid of an ovarian cyst, almost constantly, almost pathognomonically, *cells* (1) measuring five to thirty μ, with a granular appearance, and frequently with plainly distinguishable fat-globules; occasionally *cholesterin crystals* (2), well crystallized; *leucocytes* (3), *red blood-corpuscles, fat-globules* (4); *colloid concretions* (5) in cysts with inspissated contents (they have an irregular shape, are homogeneous, and of a pale-yellow color); *detritus* (6) in cysts which have repeatedly been punctured; *ciliated cells* (7) (important for differential diagnosis from ascites) lining the walls of the cyst; *pavement epithelium* (8) is not of diagnostic value, the serous membranes having the same lining.

PLATE 88

Mezger lith.

Contents of ovarian cysts.

Peyer's microscopy.

CHAPTER VIII.

MICROSCOPY OF THE SECRETION OF THE FEMALE SEXUAL ORGANS.

PLATE 89.

LEUCORRHŒA WITH PRURITUS VAGINÆ OF PREGNANCY.

SECRETION OF THE FEMALE SEXUAL ORGANS.

The smegma covering the external genitals is a mixture of the secretion of their mucous, sebaceous, and sudoriferous glands with the pavement epithelium which is continually detached from the inner surface of the sexual organs.

The secretion of the vagina, the lining of which is composed of imbricated pavement epithelium, is of acid reaction. It forms, with the detached epithelium, a whitish paste.

The secretion of the cervical canal originates from tubular glands, and is alkaline, with but few form-elements. Here the pavement epithelium is replaced by the prismatic transition epithelium; this, in its turn, makes room for the ciliated cells, which also line the cavity of the uterus, whose mode and kind of secretion are the same. In catarrhal inflammation of these parts we find an increase of secretion of mucus, with an augmentation of epithelium and leucocytes.

Parasites.—Bacilli, vibriones, and leptothrix are very frequent. On Table 89 I have represented the vaginal secretion of a pregnant woman suffering from pruritus vaginæ. The whole field was actually covered with the above parasites. *Oïdium albicans* (1), supposed to be frequent in pregnancy, was rare in this case.

Of animal parasites we have mainly to mention *Trichomonas*, an infusorium of the length of eight μ (see Plate 5). It has no peculiar significance, and is not diagnostic of gonorrhœa, but only a usual occurrence in catarrh. *Oxyuris vermicularis*, which may occur in the vagina, originally comes from the intestine.

At times it may be necessary, by means of the microscope, to establish differential diagnoses between blood-coagulum, polypus, menstrual decidua, abortion, or other pathological discharges of the uterus.

In *abortion* we may identify the fœtus or mole.

On dissecting *blood-coagula* under the microscope, we find matted fibers of fibrin inclosing red and white blood-cells and epithelium.

The *dysmenorrhœal membrane*, which is expelled with bearing-down pains, has the microscopical characters of the uterine lining. We find the columnar epithelium of the uterine glands surrounded by a stroma of connective tissue, containing large numbers of round or elongated cells.

PLATE 89

Mezger lith

Leucorrhoea with pruritus vaginae of pregnancy

Peyer's microscopy.

CHAPTER IX.

VARIOUS MICRO-ORGANISMS PROVOKING DISEASE.

PLATE 90.

PNEUMONOCOCCI.—GONOCOCCI.

VARIOUS MICRO-ORGANISMS.

Pneumonococci.—The micrococci found in the sputum of acute croupous pneumonia undergo a peculiar capsular formation, which becomes very plain by staining dry preparations. Their value for diagnosis is doubtful, because they are found in other sputum.

Pyæmia.—The pus of acute abscesses contains large numbers of micrococci in the form of torulæ; in chronic cases they do not occur constantly. In about half the cases of *tubercular* suppuration we find tubercle-bacilli.

Gonococci.—Neisser discovered in gonorrhœal pus a peculiar species of micrococcus, characterized by their forming small clusters, with relatively wide separation of the single granules. So far they are of no diagnostic value where they may be mixed with the micrococci of other secretions—e. g., that of the vagina.

PLATE 90

Mezger lith. n. Friedländer.

Various microorganisms.

Peyer's microscopy.